Northern Pintails in Eastern North America

Their seasonal distribution, movement patterns, and habitat affiliations

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Supporting Agencies and Organizations

State Agencies:

Florida Fish and Wildlife Conservation Commission
Maryland Wildlife and Heritage Service
New Jersey Division of Fish and Wildlife
North Carolina Wildlife Resources Commission
South Carolina Department of Natural Resources
Virginia Commission of Game and Inland Fisheries

Federal Agencies

U.S. Fish and Wildlife Service Regional Office, Atlanta, GA
U.S. Fish and Wildlife Service Division of Refuges

- Cape May NWR, NJ
- Mattamuskeet NWR, NC
- Merritt Island, NWR, FL
- Pea Island NWR, NC
- Pocosin Lakes NWR, NC
- Santee NWR, SC

U.S. Geological Survey, Eastern Regional Office, Kearneysville, WV

Organizations

Atlantic Flyway Waterfowl Council and Technical Section
Ducks Unlimited, Inc.
Lane Foundation, SC
New Jersey Waterfowlers Association
Post & Courier Foundation, SC
Tom Yawkey Foundation, SC
Two Rivers Farm, SC

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PREFACE

Northern pintails are known as great travelers, exhibiting enormous range between breeding and wintering areas to complete their annual life cycle. Their circumpolar distribution is testament to this journeying life style so uniquely adapted to the vagaries of climatic conditions. In North America they span large reaches of the continent, but mainly inhabit shallow wetlands of the prairie pothole region and western grasslands. Swift in flight and curious by nature, wherever they occur, they are favored by all those who hunt them or marvel at their sleek beauty.

Although much less abundant in eastern North America, pintails are present, as they were in the recent past, witnessed by gunning lore and artfully carved decoys. Yet, less is known of their movements and seasonal patterns linking breeding, migration, and wintering areas. I recall my astonishment at seeing several flocks of pintails on the Outer Banks and on sandbars amongst the vastness of Pamlico Sound, North Carolina, while conducting the January midwinter survey in the late 1980s. Diving ducks I expected to see in these open-water habitats, but not pintails. I was equally amazed at the numbers of pintails on Delaware Bay and on Bombay Hook National Wildlife Refuge during migration and by those wintering in coastal South Carolina and Florida. But, what do we know of their breeding ground affinities? Are they linked to the mid-continent population or are these birds breeding in eastern Canada?

Declining numbers of pintails in North America since the 1970s have brought into sharper focus the need to delineate population affiliations, determine vital rates, and assess habitat relationships to make informed management decisions. Traditionally, banding data from mid-continent North America have provided these answers. However, recent questions of how representative hunter recoveries are of pintail distributions throughout North America have limited the use of band-recovery data. Satellite-tracking of transmitters attached to pintails wintering in the Atlantic Flyway held greater promise to describe seasonal movements and to assess breeding ground affiliations.

While costly and challenging to implement, Dr. Rich Malecki’s enthusiasm to launch this project was infectious and resulted in the collaborative efforts of many State, Federal, and private organizations. We owe him and many other hard-working individuals a debt of gratitude for finding the resources to broaden our knowledge. Special credit is due to the Atlantic Flyway Council Technical Section for bringing this project to a successful conclusion.

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ABSTRACT

Northern pintails (*Anas acuta*) in eastern North America are a traditional bird of choice in the hunter harvest despite the fact that they comprise <3% of the average continental midwinter survey estimate. From 2003-2005, we marked 68 females from the coastal winter range between New Jersey and northern Florida with satellite-tracked transmitters to learn more about their annual distribution, movements, and habitat affiliations. Our transmitters lasted an average of 169 days (SD = 85), providing enough locations to track spring migration of 55 pintails, summer locations of 40 birds, and fall migration of 19. Spring migration (March-May) occurred along 2 primary corridors east and west of the Great Lakes, with females migrating west showing a greater affinity for winter locations south of North Carolina. Birds using the eastern corridor staged near Delaware Bay in the northern portion of the winter range, and the southern Lake Ontario/St. Lawrence River plain extending into southwestern Quebec. They departed this region in early May for more northern locations in eastern Canada. Birds migrating west toward the prairie potholes were more dispersed, but notable stopover activity was observed from north central Ohio northward to western Lake Erie. Arrival of females on mid-continent breeding areas occurred in mid- to late April. Summer (June-July) found the majority (~90%; 41 of 46) of females with active transmitters above 50^{o} N latitude, a line that runs just south of James Bay. The coasts of Hudson and James Bays in Ontario and Quebec, and southern Ungava Bay in Quebec, were primary collecting areas for summer pintails. In August, females began to shift southward and by mid-September, birds began arriving in southeastern Ontario, southwestern Quebec, and the northern part of New York. Nineteen of 23 females (68%) remained above 50^{o} N latitude in mid-September, and movement to the St. Lawrence region continued through late October. The first birds (n = 2) arrived on the winter range (below 40^{o} N latitude) in late October. The primary ecological zones used by eastern pintails, defined by Bird Conservation Regions (BCRs) of the North American Waterfowl Management Plan, were Peninsular Florida (BCR 31), Southeastern Coastal Plain (BCR 27), and New England/Mid-Atlantic Coast (BCR 30) that comprised the winter range, the Lower Great Lakes/ St. Lawrence Plain (BCR 13) used during both spring and fall migration, Eastern Tallgrass Prairie

(BCR 22) and Prairie Potholes (BCR 11) primarily used by females migrating west of the Great Lakes in spring, Arctic Plains and Mountains (BCR3) used in summer, and Taiga Shield and Hudson Plains (BCR 7) used in summer and fall. More detailed descriptions of areas used within these regions are described in the report. Also included is data on midwinter survey estimates, band recoveries, and harvest information for pintails in eastern North America.

INTRODUCTION

The northern pintail (*Anas acuta*) is one of the most widely distributed duck species in North America. Prior to the 1980s, the species ranked with the mallard (*Anas platyrhynchos*) and scaup (*Aythya sp.*) as 1 of the 3 most abundant waterfowl species on the continent. Since then the size of the continental breeding population has declined dramatically; 1.8 million pintails in 1991 compared with 7 million in 1972 (Fig. 1). More recently (1994-2003), the estimated size of the continental breeding population has averaged ~2.8 million (U.S. Fish and Wildlife Service [USWFS] 2004); a figure well below the 5.6 million breeding population objective established under the North American Waterfowl Management Plan (North American Waterfowl Management Plan 2004).

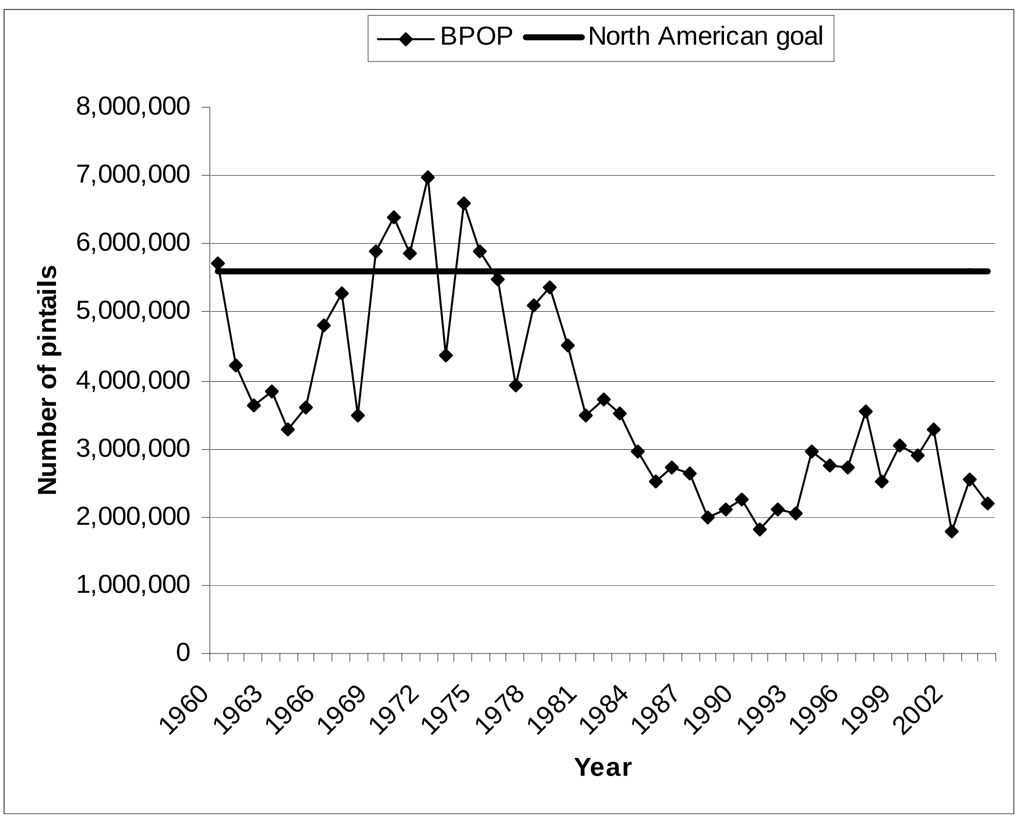

Figure 1. Number of northern pintails in the spring Breeding Population Survey (BPOP), 1960-2004 (USFWS 2004).

In 1999, Sheaffer et al. assessed the status of the North American pintail population and developed quantitative models to estimate annual survival of the population, its harvest distribution, harvest rate, non-harvest survival rate, annual harvest, and recruitment. The results, integrated into a national adaptive harvest management strategy for pintails, indicated that,

1) variation in the size of the continental population depends on overall rates of annual survival and recruitment,
2) there exists substantial variation in survival and recruitment rates among pintails affiliated with different geographic regions, and
3) issues relating to population size and productivity should be assessed regionally to better understand the status of the species.

Data compiled by Sheaffer et al. (1999) were from regions of the continent where the highest densities of pintails occur. These included nesting areas in Alaska, the prairie-pothole regions of southern Canada and the northern Great Plains, and major wintering areas in the Central Valley of California, the coasts of Mexico, and the Gulf coast of Louisiana and Texas. This is the "heart" of pintail country in North America and the source of most existing data.

In the Atlantic Flyway, pintails winter primarily in the coastal zone between New Jersey and Florida. Midwinter numbers average ~47,000 (1994-2003), which is <3% of the continental population (USFWS 2005*a*). However, despite the low contribution to the continental population, the pintail has long been regarded as a traditional bird of choice by hunters in the Atlantic Flyway. This is especially true in the central and southern portion of the flyway, where North and South Carolina generally comprise the largest proportion of the mid-winter estimate (Appendix 1).

Despite the high regard that exists for pintails in the Atlantic Flyway, relatively little is known about the status of eastern pintails and their relationship to the larger mid-continent breeding population. Hunter recoveries from pintails banded primarily in mid-continent North America during 1966-1995 indicated that <5% of the harvest of pintails banded in Canada and <8% of the pintails banded in the U.S. were harvested in the Atlantic Flyway (Sheaffer et al. 1999). We question, however, the ability of the mid-continent banded sample to truly reflect the continental population. Little is known about numbers and distributions of breeding pintails in eastern North America, and recoveries from pintails banded in the central and western portion of the continent represent an unknown proportion of the pintail population wintering in the Atlantic Flyway,

The intent of this study was: (1) to assess the breeding ground affiliations of female pintails wintering in the Atlantic Flyway, (2) to describe the chronology of spring and fall pintail migrations and movements, and (3) to identify important staging, stop-over areas, and habitats used during their annual cycle.

BACKGROUND AND STATUS OF EASTERN PINTAILS

Historically, numbers of pintails counted during midwinter waterfowl surveys in the Atlantic Flyway exceeded 100,000 birds (Appendix 2). Estimates averaged ~280,000 for 1955-1960, ~175,000 for 1961-1965, and ~148,000 for 1966-1970. By the early 1980s, midwinter estimates had dropped below 70,000, where they have remained.

Midwinter estimates in the Atlantic Flyway can fluctuate dramatically by state (Appendix 1). Such fluctuations are most likely related to the influence of weather on pintail movements along the Atlantic coast at the time the surveys are conducted. However, on average, ~55% of the pintail midwinter estimate occurs in North Carolina, 15% in South Carolina, 10% in Florida, 5-6% in New Jersey, Delaware, and Maryland, and 3% in Virginia.

Recoveries of winter-banded pintails from the Atlantic Flyway, 1966-1995 (Sheaffer et al. 1999), suggest that birds marked on the outerbanks of North Carolina above 35^{o} N latitude and north along the coast to the 40^{o} N latitude line in New Jersey have similar distributions of recoveries (Fig. 2). Birds marked inland from the North Carolina outerbanks showed a very different distribution pattern, while pintails banded in the southern coastal region of South Carolina and the Gulf coast of Florida were again different. Pintails wintering in South Carolina and Florida were most similar in their recovery distributions to pintails banded in the Gulf coast states of the Mississippi Flyway and Texas.

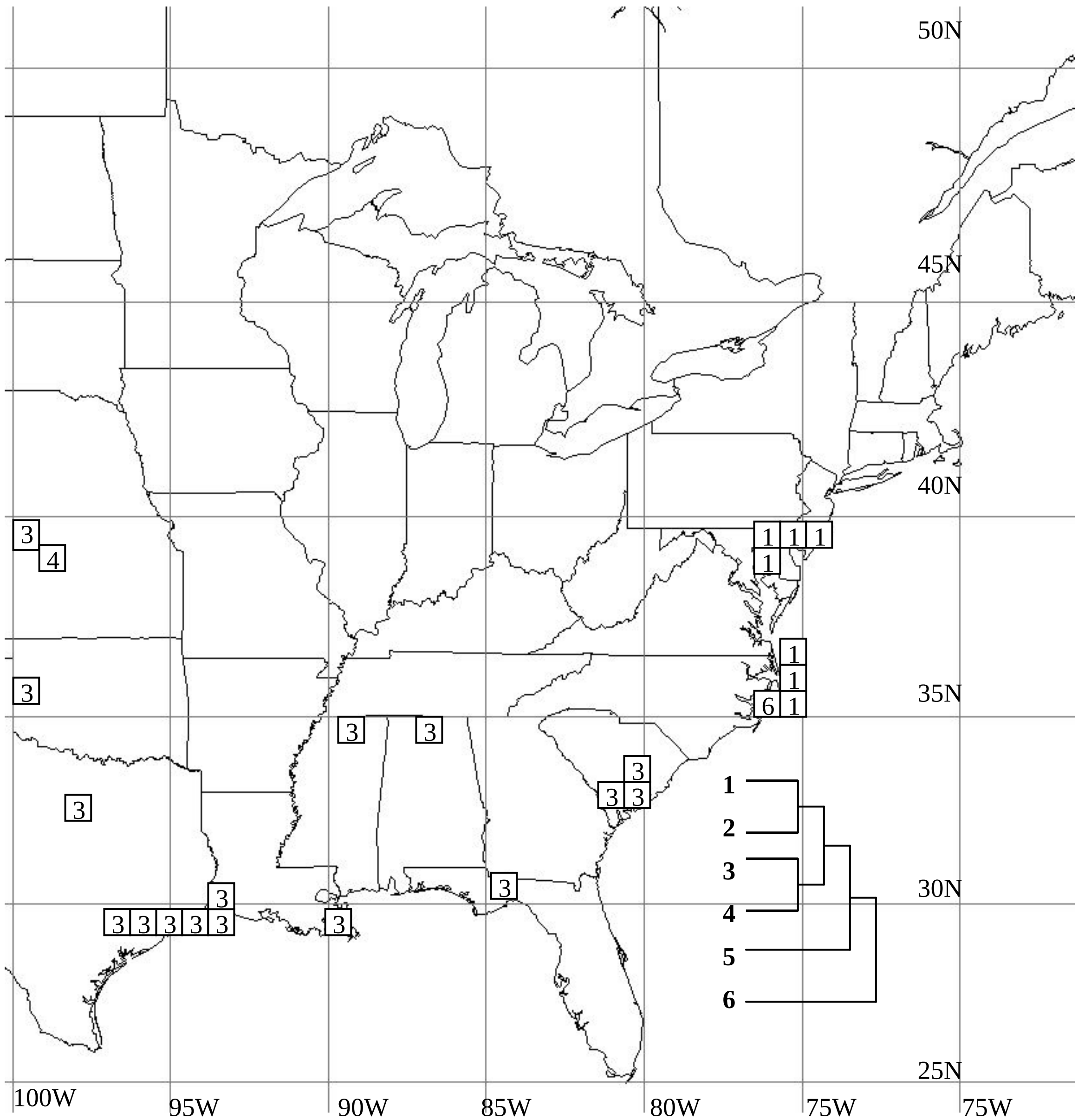

Figure 2. Degree blocks with similar distributions of recoveries from pintails banded postseason, south of 48° N latitude, during 1966-1995. Blocks with similar recovery patterns were identified using a multi-response permutation procedure (from Sheaffer et al. 1999).

Hunter recoveries from pintails banded during winter in the Atlantic Flyway (Appendix 3) demonstrate that harvest of these birds occurs primarily in eastern North America. Of the 999 recoveries during 1965-2004, 73% (*n* = 725) occurred in the Atlantic Flyway states and another 15% (*n* = 147) in Atlantic Flyway Canada (Ontario, Quebec, and Maritime provinces). Recovery distributions appear similar between males and females (Appendix 3). Of the 809 recoveries from birds banded in the states from North Carolina northward (Figure 3), most occurred in the Atlantic Flyway states (77% , *n* = 622); 5% (*n* = 42) occurred in the Mississippi Flyway states, and 15% (*n* = 132) occurred in Atlantic Flyway Canada. In contrast, birds banded in South Carolina southward had a higher proportion of recoveries in the Mississippi Flyway (Figure 4); 54% (*n* = 103) occurred in the Atlantic Flyway states, 21% (*n* = 40) were recovered in the Mississippi Flyway states, and 20% (*n* = 21) were recovered in Atlantic Flyway Canada.

During 1999-2004, the pintail harvest in the Atlantic Flyway states averaged ~18,500 (range 10,300–25,200; Appendix 4). This figure is 30% less than the historic long-term average of ~26,400 for 1971-1997 (Appendix 5). The major harvest areas for pintails within the flyway states during 1999-2004 were North Carolina with an average of 25% of the harvest, New York (15%), Maryland (15%), Florida (10%), Delaware (10%), Virginia (7%), South Carolina (4%), and New Jersey (5%). In comparison to 1971-1997, the percentage of the flyway harvest occurring in North Carolina (24%) has not changed appreciably. However, an increase from historic proportions has occurred in New York, which was previously 10%, Delaware (6%), and Maryland (9%). A decrease is noted in Florida (previously 17%), New Jersey (10%), and South Carolina (10%). Thirty and 60 day hunting seasons with a 1 pintail/day bag limit have been the standard pintail season in the flyway states since 1987 (Appendix 6). Notable are the harvest figures for 2002 and 2003, when a 30 day season and 1 pintail/day bag limit was implemented within the regular waterfowl season framework. The resultant pintail harvest was higher than for any of the 30 day and 1 bird season figures recorded for 1988-1993, and was similar to harvest estimates for the previous 2 years (calculated under the current HIP system) with 60 day season lengths.

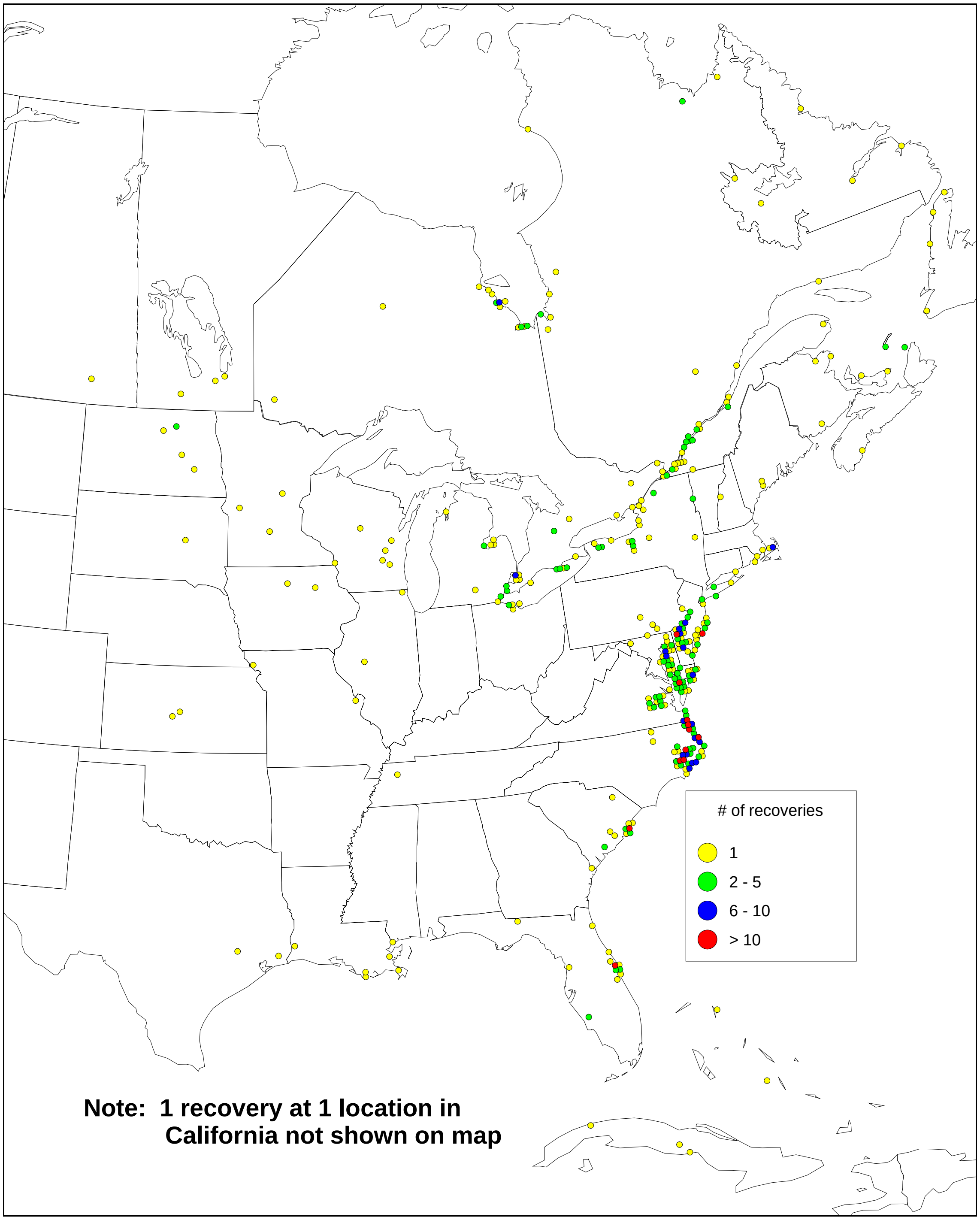

Figure 3. Recoveries of northern pintails banded during winter (January – March), 1965-2004, in the Atlantic Flyway states from North Carolina northward. Birds were reported to the USGS Bird Banding Lab as shot or found dead.

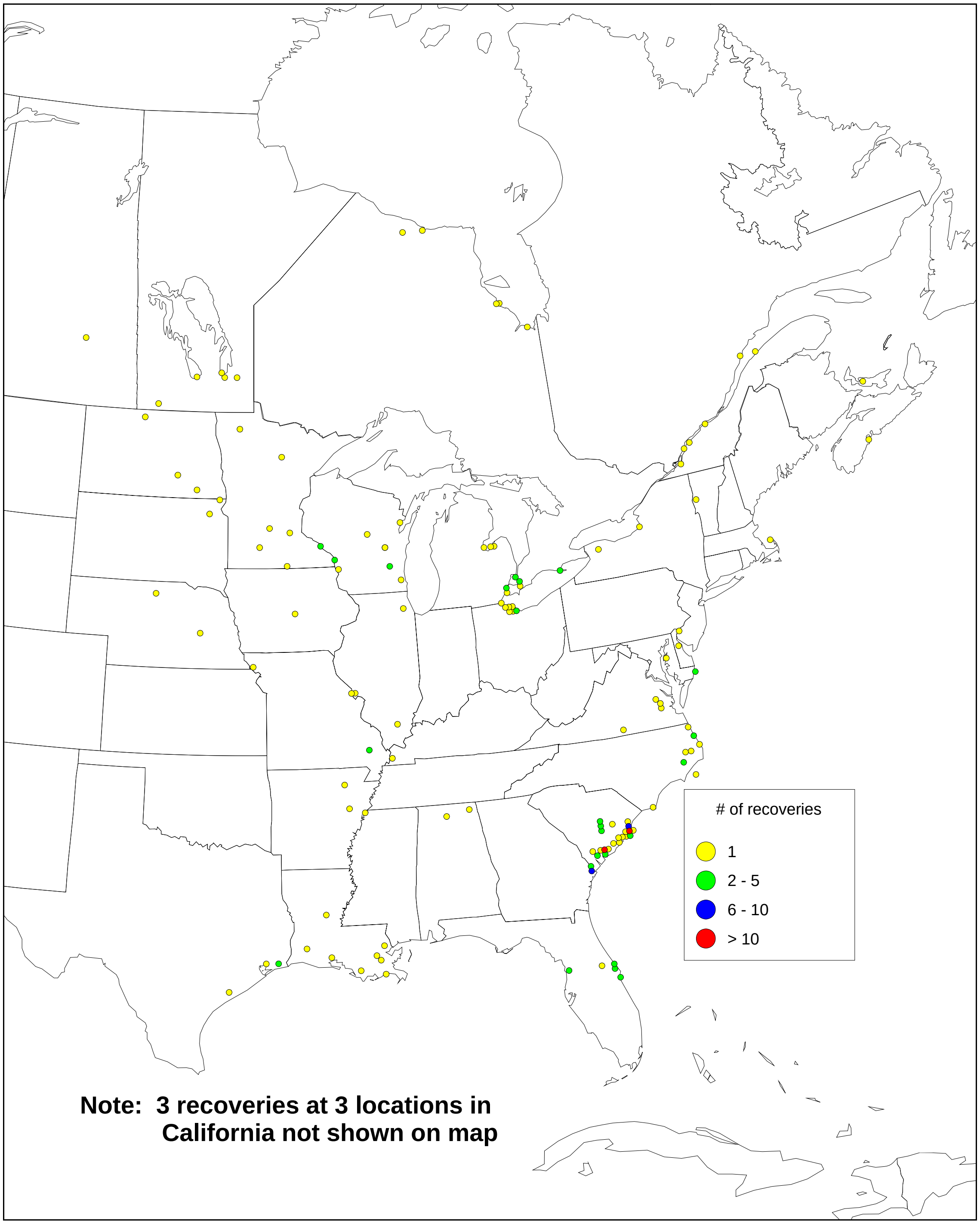

Figure 4. Recoveries of northern pintails banded during winter (January – March), 1965-2004, in South Carolina, Georgia, and Florida.

In Canada,, the harvest of pintails in the Maritime provinces, Quebec, and Ontario averaged ~15,300 birds during 1996-2004 (range: 9,769 - 19,885; Appendix 7). In comparison, the estimated harvest over the historic long-term period from 1972-1995 averaged ~31,600 (range: 12,645-61,500). The difference represents an overall reduction in the eastern Canada pintail harvest of ~50%. The decline may be related to the general decline in pintail numbers seen across the continent since the 1970s (Fig. 1) and/or reflect a decline in hunter numbers in eastern Canada. Quebec and Ontario are the major eastern provinces harvesting pintails, each accounting for ~42% of the average harvest estimated since 1996. Compared to 1972-1995, this percentage represents a decline in the proportion of the harvest occurring in Quebec (from 53%), and an increase in the percentage occurring in Ontario (from 34%). If the sales of Migratory Game Bird Hunting Permits for Ontario and Quebec (Appendix 8) reflect numbers of waterfowl hunters, both Ontario and Quebec have experienced a 50% decline in the average number of hunters for the period 1996-2004 (Ontario: 64,550; Quebec: 30,442), compared to 1972-1995 (Ontario: 129,081; Quebec: 60,632). Waterfowl hunting seasons for eastern Canada typically exceed 50 days with opening dates no later than the third week in September and a bag limit of 6 ducks/day. No special restrictions are made for pintails, and weather, as it affects the southward movement of birds in the fall, is usually considered a more likely determinate of the availability of pintails for harvest in eastern Canada than length of the hunting season.

Age ratios in the harvest can provide an index to annual production if they are adjusted for differential vulnerability of young and adult birds to harvest. The paucity of pre-season banding data from pintails in eastern Canada precludes adjustment for vulnerability. However, young-to-adult age ratios in the 1975-2005 harvest estimates (Appendix 9) for eastern Canada (Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland; mean = 6.01, range 2.35–11.87) typically were higher than for Manitoba and Saskatchewan (mean = 3.28, range 1.14–6.50), and western Canada (mean = 3.46, range = 1.12–6.07). These estimates are biased relative to any biological interpretation of productivity, but they do suggest a distinct difference in early season harvest patterns for eastern pintails.

METHODS

In February 2003, 10 female pintails were trapped in South Carolina and fitted with 30-g satellite-tracked transmitters (Platform Transmitter Terminal [PTT], Model PTT-100, Microwave Telemetry, Inc., Columbia, MD, USA[1]) in a pilot effort to determine if satellite tracking was feasible. Transmitters were placed dorsally between the wings using 2 teflon ribbon loops positioned around the body posterior to the wings and anterior along each side of the neck. Both loops were connected ventrally by a short loop of ribbon at the sternum.

In February, 2004, 40 females were aged, weighed, and similarly fitted with newly developed 20-g PTT-100 transmitters in Florida (3), Maryland (4), New Jersey (6), North Carolina (16), South Carolina (8), and Virginia (3) and in 2005, an additional 18 females were marked in New Jersey (4), North Carolina (12) and Virginia (2) (Fig. 5). In each year, we attempted to select for heavier, adult females. We also attempted to distribute our marked sample to account for some of the inherent variability in the winter distribution of pintails, but logistics and cost were major considerations limiting our success.

Each 30-g transmitter had specifications for ~700 hours of battery life, while the 20-g units were expected to last ~400 hours. All transmitters were programmed for 6 hours of transmission every 5 days for the life of the battery. Expected battery life was ~580 days (30-g PTT) and ~330 days (20-g PTT). All transmitters were equipped with temperature, voltage, and activity sensors that helped differentiate between transmitter failure and death of a bird. The 20-g transmitters contained a ground-tracking feature that allowed their recovery when mortality was sensed. However, in most cases, we were unable to determine a definitive cause of death.

Data were obtained from the Argos satellite system of the French Space Agency via a preferential tariff agreement with the U.S. Department of Commerce's National Oceanic and Atmospheric Administration. Locations were classified by Argos based on their estimated accuracy, which depended on the number of transmissions received from a PTT during a satellite overpass. Location classes 3, 2, and 1 had accuracy ratings within

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[1] Use of product names does not constitute endorsement by the federal government.

Figure 5. Locations where pintails were captured and marked with a satellite-tracked transmitter, 2003–2005.

1,000 m. Accuracy for location class 0 was >1,000 m, and location classes A and B did not receive enough transmissions during an overpass for accuracy to be evaluated by Argos (Argos 1996). Britten et al. (1999) demonstrated that poor locations (classes 0, A, and B) received from PTT-100 satellite transmitters (30 g) were <35 km from the true location of the PTT. We included all locations with a classification of 3, 2, 1, 0, A, or B because the accuracy of these classes was sufficient to describe migratory pathways.

Argos estimates locations by measuring the Doppler shift of the PTT signals during a satellite overpass and provides 2 location estimates for each satellite pass (Service Argos 1996). Argos designates the location with the better frequency continuity as the best location (location 1), and the alternate location is designated as the image (location 2). Examination of our data suggested that on several occasions location 2 was a more probable fix than location 1 based on the flight dynamics of pintails. We developed a sorting routine similar to that of Britten et al. (1999) that sequentially identified locations that were biologically impossible. The initial location for each bird was the site of release after banding. For each pair of locations, flight speed (distance/hr) was calculated from location 1 in the previous location pair, and also to location 1 of the next location pair. If the bird had flown <65 km/hr to reach both locations 1 and 2, we selected location 1. If the bird had flown >65 km/hr to reach location 1 but <65 km/hr to reach location 2, we selected location 2. If both locations violated the 65 km/hr rule, we deleted both.

Pintails were divided into 2 groups based on their spring migration routes along 1 of 2 primary corridors; 1 group remained east of Michigan and the Great Lakes, while the second group headed west of the Great Lakes. Movements of pintails from each group were analyzed by temporal periods within the annual cycle: March-May (spring); June-July (summer); August-December (fall). To examine seasonal distributions of pintails, we plotted all locations of individuals known to be alive. We subsequently divided each month into roughly a 2-week interval, and plotted the last location received from each individual during a given interval to describe temporal and spatial patterns of migration chronology. We had no way of discriminating between specific activities, such as nesting or molting, or whether attempts to nest actually occurred. However, we were able to differentiate among habitats used during specific periods and to relate these habitats to seasonal behaviors of pintails.

We quantified large-scale habitat use by assigning spring, summer, and fall locations of individual birds to Bird Conservation Regions (BCRs; Appendix 10). BCRs are ecologically defined units that provide a consistent spatial framework for bird conservation across North American landscapes (North American Bird Conservation Committee [NABCI] 2000). Within each BCR, we identified the key landscape features used by female pintails based upon clusters of locations observed among individuals. We used ArcGIS 9.1 (ESRI 2005) to identify where locations were clustered by creating a density surface from the geographic extent of all locations. The geographic extent was divided into approximately 250 rows and 400 columns forming individual cells representing 0.14^{o} of latitude and 0.14^{o} of longitude. Each cell was then assigned a value equal to the number of locations within 1^{o} of latitude and longitude around the cell. This process was performed separately for pintails that migrated east or west of the Great Lakes. We then identified specific geographic areas with clusters of high cell values which we assumed to contain key landscape features important to pintails during some portion of their annual life cycle.

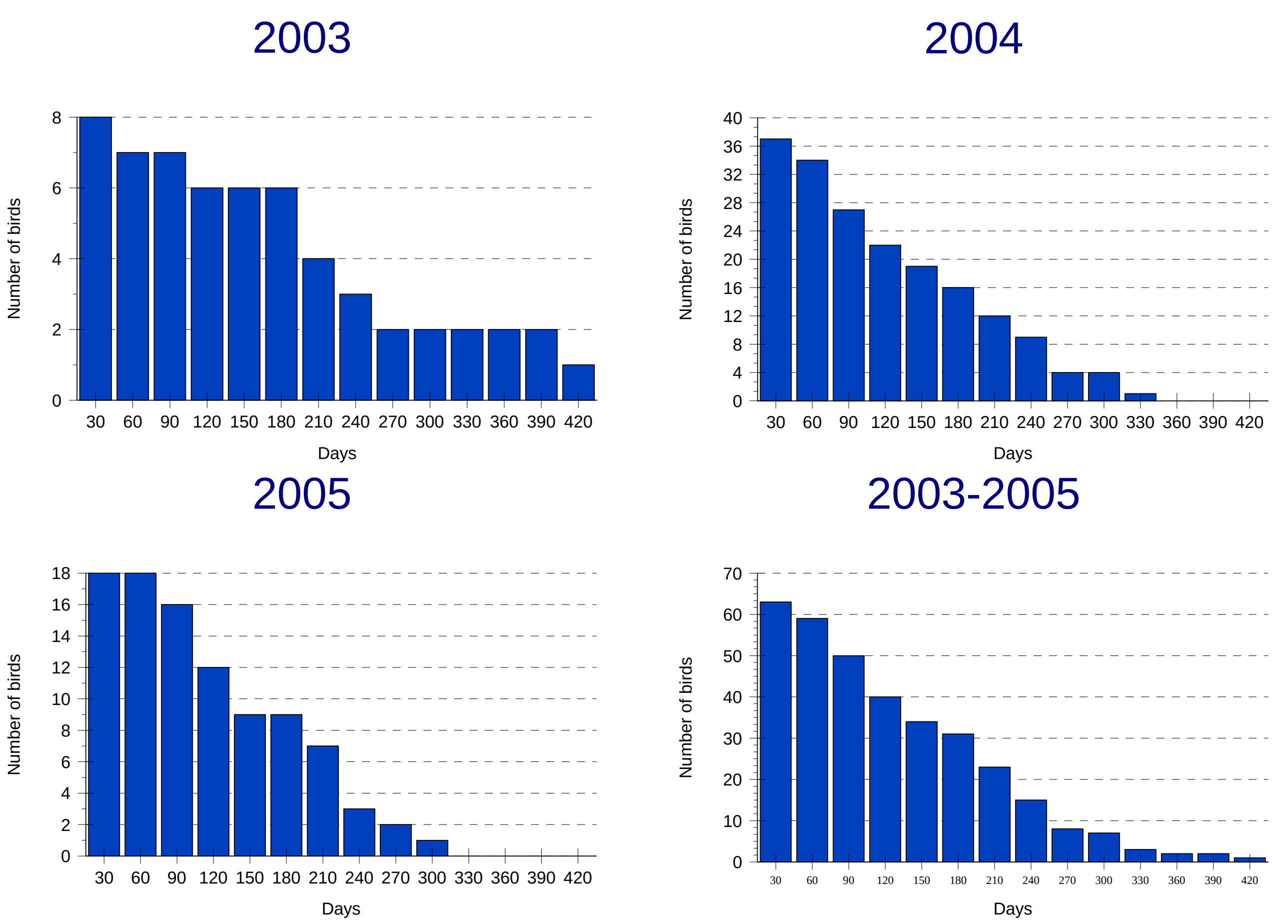
RESULTS

We received 10,897 Argos locations from the 68 females marked during 2003-2005 (Table 1). The number of high quality locations (LC = 0, 1, 2, or 3) averaged 66%. This percentage increased appreciably in each year (2003: 53%; 2004: 64%; 2005: 75%) Average longevity of the satellite transmitters was 169 days (SD = 85). This is shown graphically by 30-day intervals for each year (Fig 6). The longest monitoring of a 30-g PTT was 401 days and that for a 20-g PTT was 335 days. There was some indication that heavier females marked in 2005 with an average weight of 878.3 g (SD = 63.6), compared to 860.7 g (SD = 73.6) for birds in 2004, survived the first 90 days at a higher rate (2005: 88.9%, n = 16 versus 2004: 69.2%, n = 27), but by 150 days survival percentages were not that different (~50%). Of the 68 birds released, 55 provided enough locations to track spring migration, 40 provided locations during the summer, and 19 provided locations during fall migration.

Table 1. Proportional distribution of locations from satellite-tracked transmitters on northern pintails by location class rating (LC).

	Year of banding							
	2003		2004		2005		2003-2005	
LC	n	%	n	%	n	%	n	%
3	16	1.4	43	0.7	195	5.4	254	2.3
2	38	3.4	172	2.8	431	12.0	641	5.9
1	106	9.4	871	14.1	873	24.3	1850	17.0
0	436	38.5	2847	46.2	1194	33.2	4477	41.1
A	251	22.2	946	15.3	426	11.8	1623	14.9
B	267	23.6	1135	18.4	425	11.8	1827	16.8
Z	18	1.6	153	2.5	54	1.5	225	2.1
total	1,132		6,167		3,598		10,897	

Figure 6. Number of satellite-tracked pintails known to be alive after 30-day intervals.



Spatial Distribution

Spring migration (March–May) occurred along 2 primary corridors east and west of the Great Lakes (Fig. 7). To the east, birds (*n* = 44) moved up the Atlantic coast to the northern Chesapeake Bay-Delaware Bay area. They followed pathways along the Susquehanna and Delaware River systems to the Finger Lakes and southern Lake Ontario plain in New York, then northeast along the St. Lawrence River Valley that extends through New York, southeastern Ontario, and southwestern Quebec. From here, they dispersed to locations in Labrador, northern Quebec, and eastern Ontario.

The western corridor showed birds (*n* = 11) migrating in a northwest direction through Ohio, Indiana, Illinois, Michigan, and Wisconsin, which border the Great Lakes, and into Minnesota, North Dakota, and southern Manitoba. Once west of the Great Lakes, birds dispersed either in a northwest direction into Saskatchewan or traveled northeast to northern Ontario.

Of 6 birds marked in South Carolina in 2003 that completed a spring migration, 2 used the eastern spring migration corridor and 4 went to the west (Table 2). In 2004, this pattern was repeated with 3 birds migrating to the east and 3 to the west. No birds were captured in South Carolina in 2005. North Carolina had 1 of 9 birds in 2004, but none of 12 birds in 2005, migrate to the west. The only other state with birds migrating to the west was Virginia, with 2 of 3 birds doing so in 2004 and 1 of 2 in 2005.

Table 2. Number of pintails from each state that completed a spring migration and the direction they took relative to the Great Lakes.

	2003			2004			2005			2003-2005		
	n	East	West	*n*	East	West	*n*	East	West	*n*	East	West
MD				4	4	0				4	4	0
NJ				6	6	0	4	4	0	10	10	0
VA				3	1	2	2	1	1	5	2	3
NC				9	8	1	12	12	0	21	20	1
SC	6	2	4	6	3	3				12	5	7
FL				3	3	0				3	3	0
total	6	2	4	31	25	6	18	17	1	55	44	11

Figure 7. Movements of satellite-tracked pintails during spring (March–May), 2003-2005.

Summer locations of all pintails (n = 40; Fig. 8) showed a strong affiliation with the Hudson and James Bay coast of Ontario and Quebec, southern Ungava Bay, and the interior lakes region south of the Ungava Peninsula in northern Quebec. Other notable sites to the east and west include smaller clusters of locations in the Happy Valley-Goose Bay area of central Labrador and in northern North Dakota. More scattered are satellite fixes located in the St. Lawrence River Valley, Smallwood Reservoir region of western Labrador, and sites on South Hampton Island and the Keewatin and Mackenzie districts of the Northwest Territories, north of 60^{o} N latitude.

Figure 8. Locations of satellite-tracked pintails during summer (June–July), 2003-2005.

Fall movement was more difficult to characterize because of the smaller sample size (n = 19; Fig. 9). Only 1 bird migrating west of the Great Lakes in the spring completed a fall migration. However, tracking data were incomplete for this bird during the fall. Of the eastern corridor birds, there was a general retracing of the spring migration pattern back through the Lake Ontario-St. Lawrence River region. However, perhaps more notable was a westward shift in those eastern spring migrating birds returning from the western Hudson and James Bay coasts. Their fall return passage was as far west as the prairie-pothole region and through the central Great Lakes area, with an apparent focus in western Lake Erie, prior to their return to coastal wintering locales.

Figure 9. Movements of satellite-tracked pintails during fall (August–December), 2003-2005.

Temporal Movement

Spring migration of pintail hens was underway by early March, as evidenced by movements north of the 40^{o} N latitude line that approximates the northern edge of the winter range in New Jersey, and west away from the coast (Fig. 10a and Fig. 11a). Of 44 birds migrating east of the Great Lakes, 36 (82%) were below 40^{o} N latitude in mid-March and 8 (18%) were dispersed through Pennsylvania, New York, and Michigan. Spring staging was apparent in the Delaware Bay area. By late March (Fig. 10b and 11b), only 17 birds (39%) were below 40^{o} N latitude and this number was reduced to 6 of 43 (14%) in mid-April (Fig. 10c and 11c). Four birds remained south of 40^{o} N latitude through late April (Fig. 10d and 11d), with 1 bird, probably injured or defective in some way, located there through mid-July

In late March, eastern migrating hens collected in the Finger Lakes/Lake Ontario/St. Lawrence River plains of northern New York (Fig. 10b). This was followed in April by a northeastward shift along the St Lawrence River towards the 45^{o} N latitude line that extends through northern New York, southeastern Ontario, and southwestern Quebec. By late April, 39 of 43 birds (90%) were in this region (Fig. 10d). A major dispersal from the St Lawrence River region to points throughout northeastern Canada occurred in early May (Fig. 10e) and by late May (Fig. 10f), 34 of 41 birds (83%) were in regions north of 50^{o} N latitude.

Pintails migrating to the west of the Great Lakes dispersed in a northwesterly direction with 9 of 11 birds (80%) north of 40^{o} N latitude and as far west as 90^{o} W longitude by late March (Fig. 11b). By mid-April, 5 of 11 birds (45%) had migrated beyond the western edge of the Great Lakes (90^{o} W longitude) and north of 45^{o} N latitude (Fig. 11c). This increased to 9 of 11 (82%) by late April (Fig. 11d). Following arrival to the grasslands region of northwestern Minnesota, northern North Dakota, and southern Manitoba, birds then dispersed throughout May (Figs. 11e and 11f) in northwest and northeast directions to locations above 50^{o} N latitude in Saskatchewan, Manitoba, and Ontario.

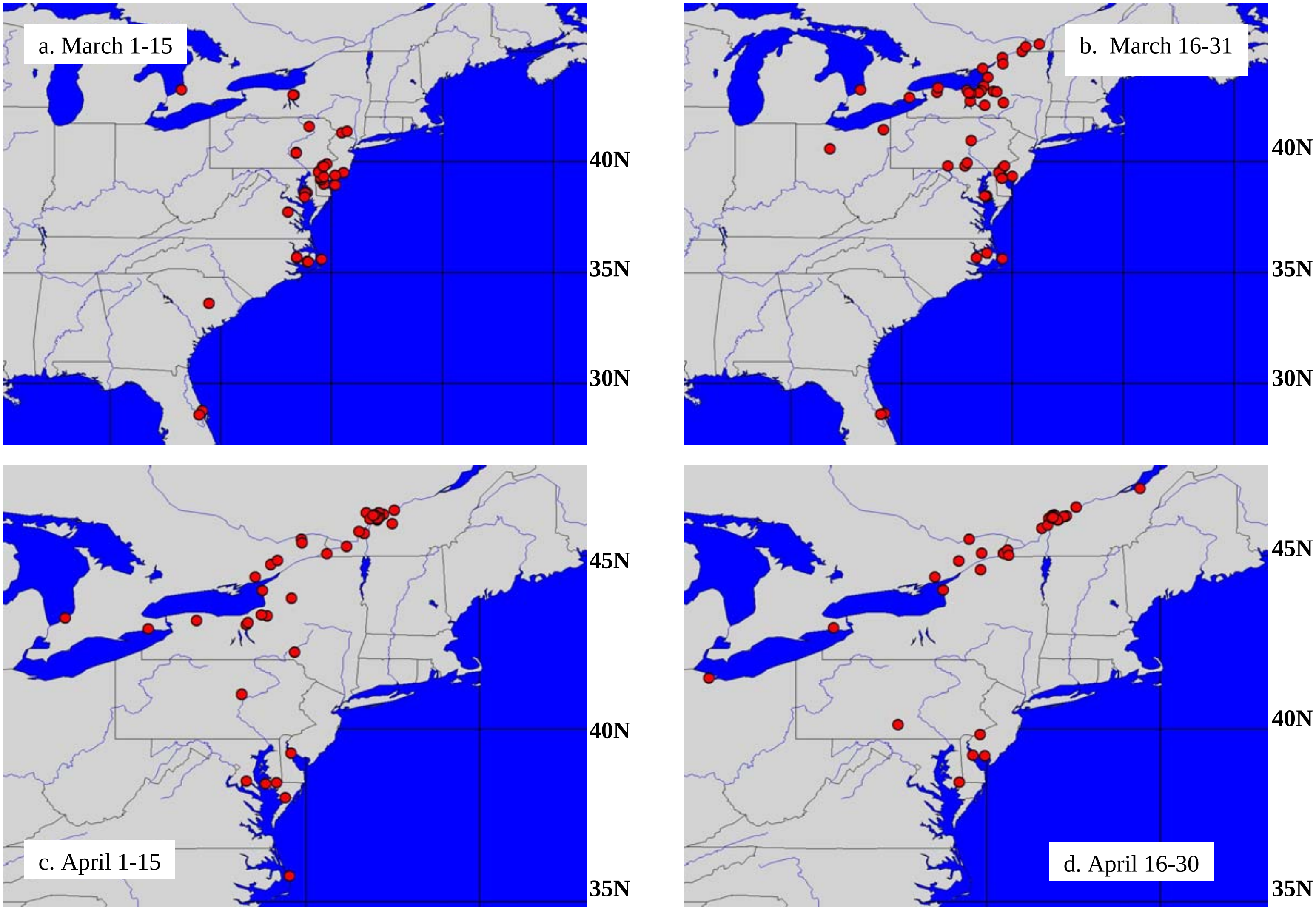
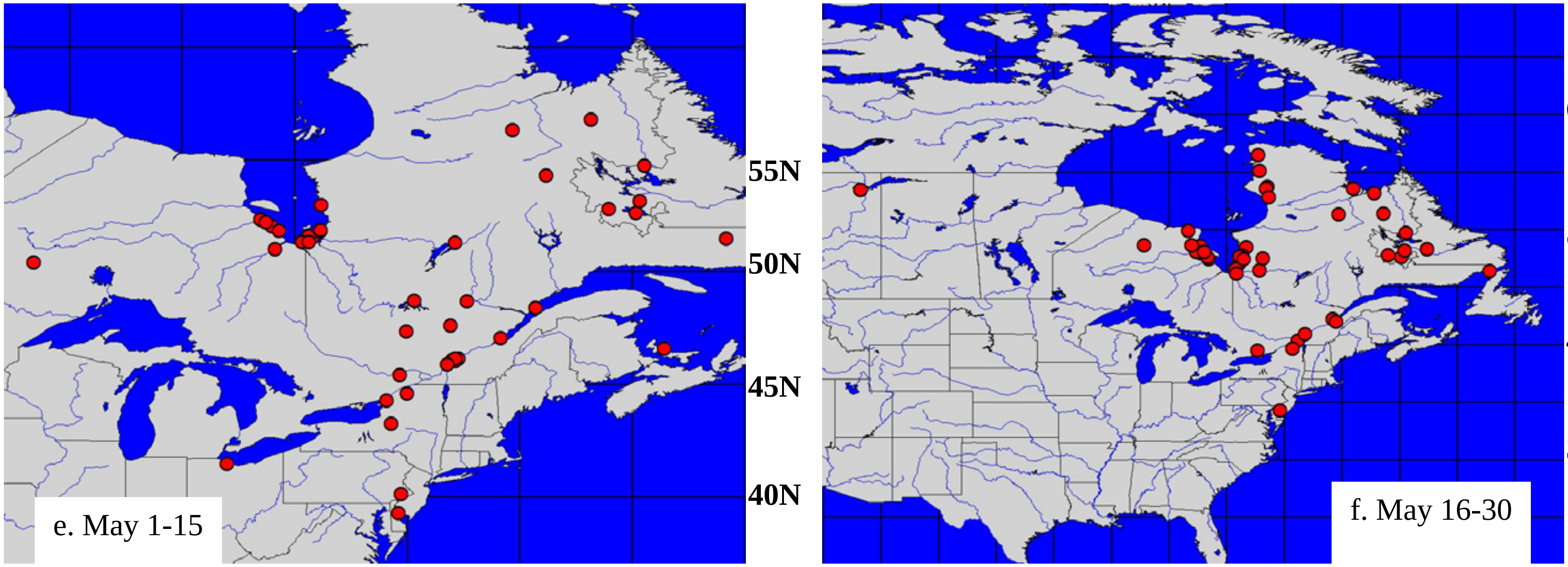


Figure 10. Locations of satellite-tracked pintails during spring migration in the eastern corridor.



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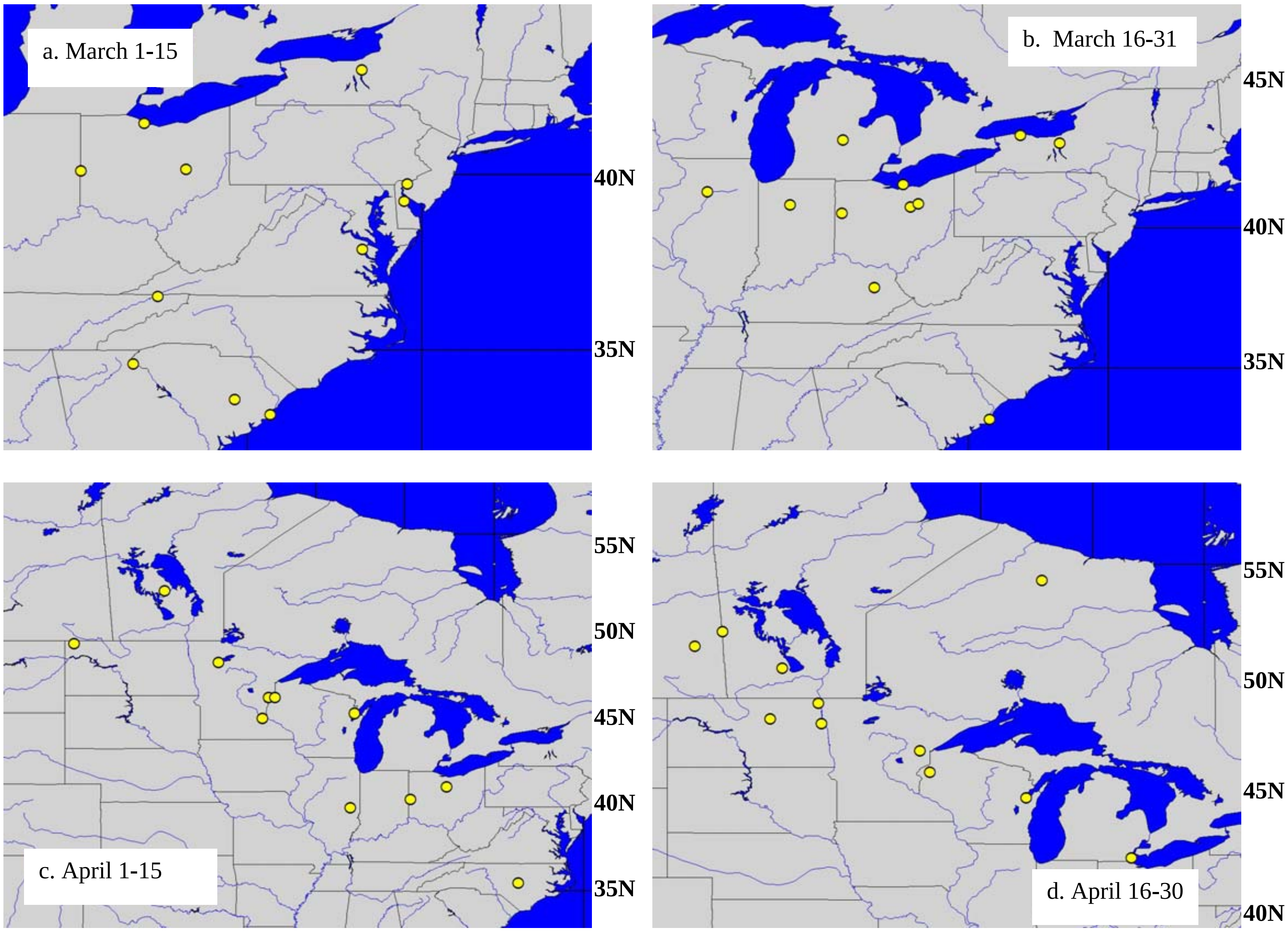

Figure 11. Locations of satellite-tracked pintails during spring migration in the western corridor.

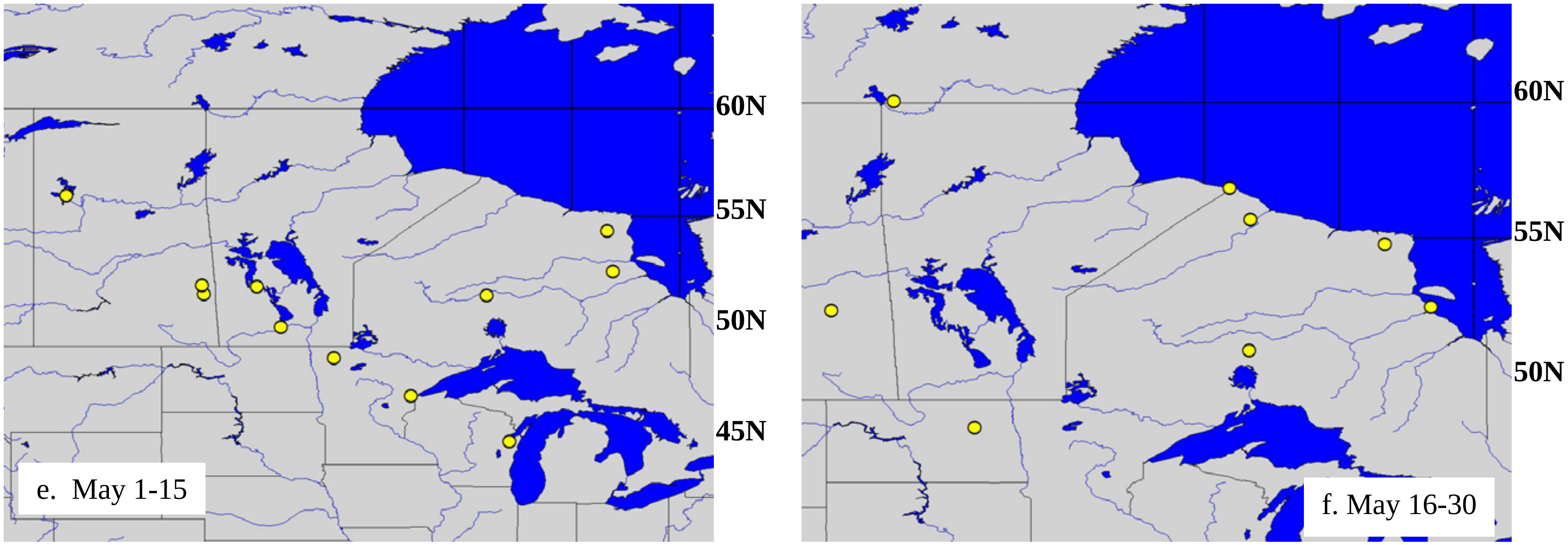

Figure 11 (continued).

In mid-June, the majority of pintails (~90%; 41 of 46) that had migrated both east and west of the Great Lakes were above 50^{o} N latitude (Fig. 12a); 7(15%) of these being above 60^{o} N latitude. This percentage was relatively constant throughout the summer (June-July), although the number of birds monitored declined to 34 by late July. The west coast of James and Hudson Bays, along the Ontario border, was a primary collecting area for summer pintails (Fig. 12), as was the east coast of Hudson Bay along the Ungava Peninsula of northern Quebec, and the southern coast of Ungava Bay. A clustering of birds also occurred interior, just south of the Ungava Peninsula, in June (Fig. 12a and 12b), followed by dispersal from this region in July.

During August, there was evidence of birds shifting southward along the western coast of Hudson Bay into the James Bay area and a few birds (n = 3) moved below 50^{o} N latitude (Fig. 13a and 13b). By mid-September, there was only 1 bird north of 60^{o} N latitude, but 19 of 23 birds (68%) remained above the 50^{o} N latitude line that runs just south of James Bay (Fig. 13c). This percentage declined slightly to 59% (13 of 22 birds) by late September, as birds began to arrive in southeastern Ontario, southwestern Quebec, and the Finger Lakes area of New York. In mid-October, 9 of 20 birds (45%) remained north of 50^{o} N latitude, declining to 6 of 17 (35%) by the end of October. By late October, the first birds (n = 2) were back on the winter range, below 40^{o} N latitude (Fig. 13f).

A fairly dramatic loss in the number of monitored birds occurred in November, when we went from 15 to 9 birds in mid-November, then 5 by late November. All 9 birds were below 45^{o} N latitude in mid-November, with 3 south of 40^{o} N latitude (Fig. 13g). Four of the remaining 5 birds moved south of 40^{o} N latitude by late November (Fig. 13h) and the last bird did so after mid- December.

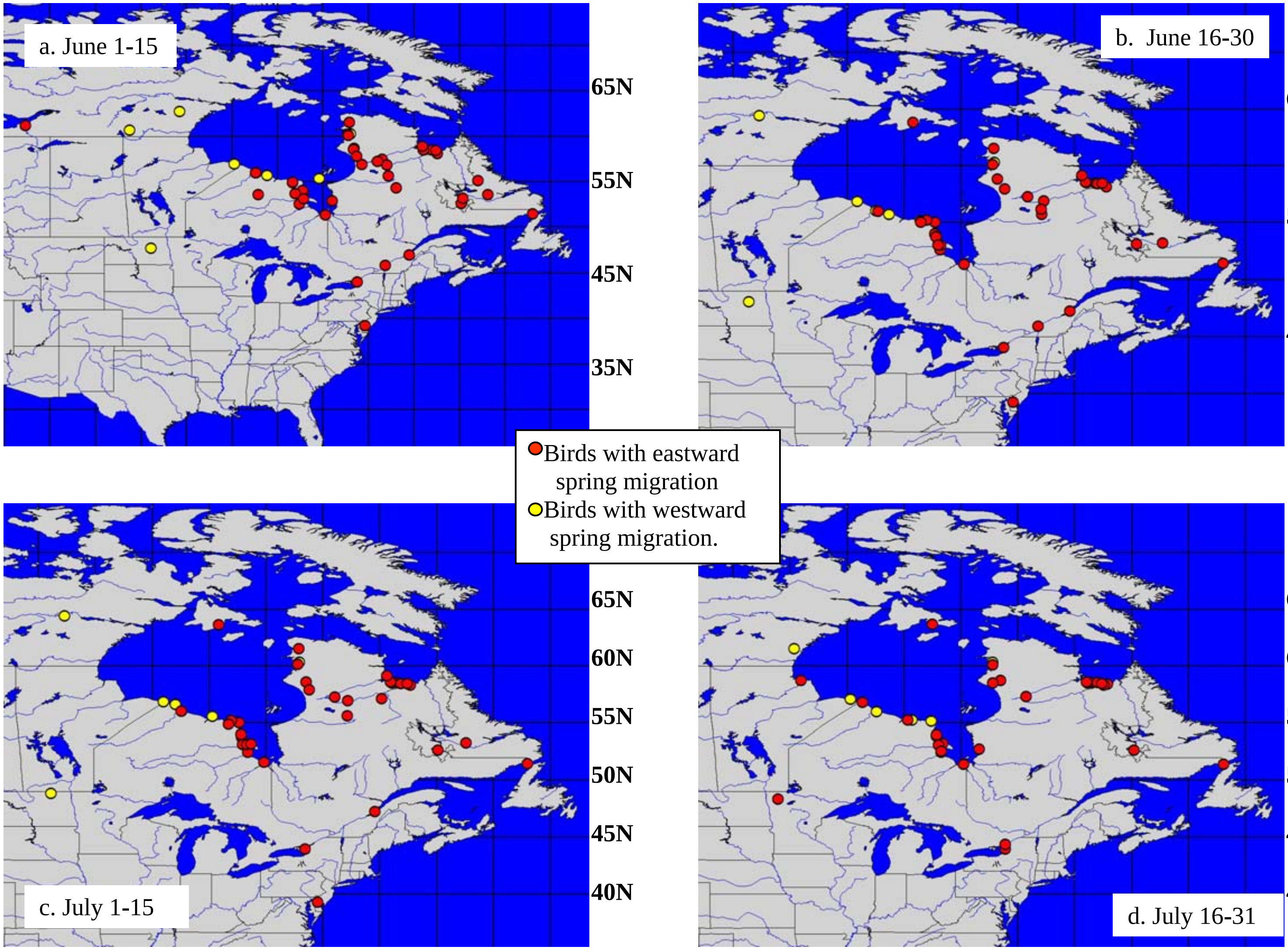

Figure 12. Locations of satellite-tracked pintails during summer.

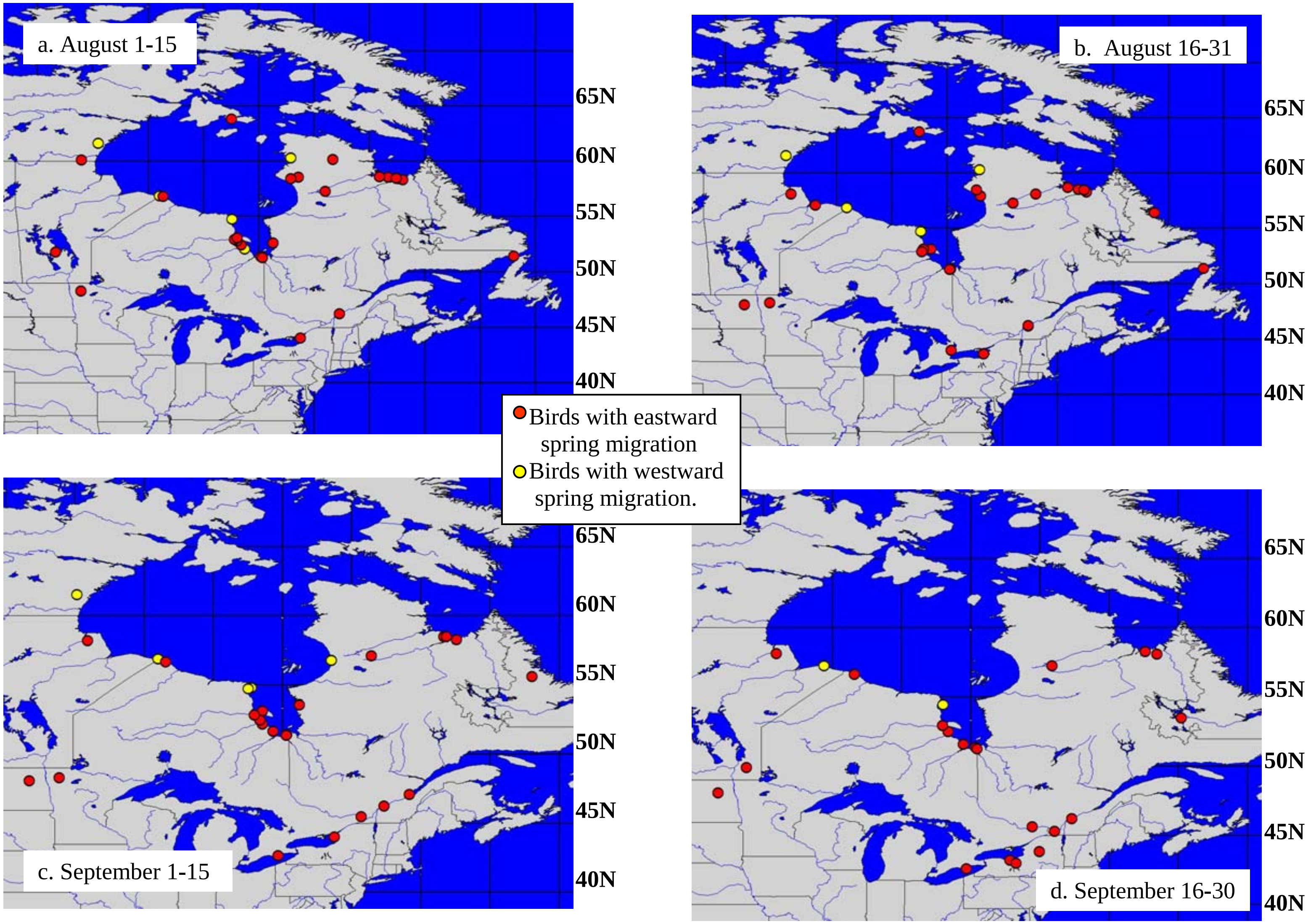

Figure 13. Locations of satellite-tracked pintails during fall.

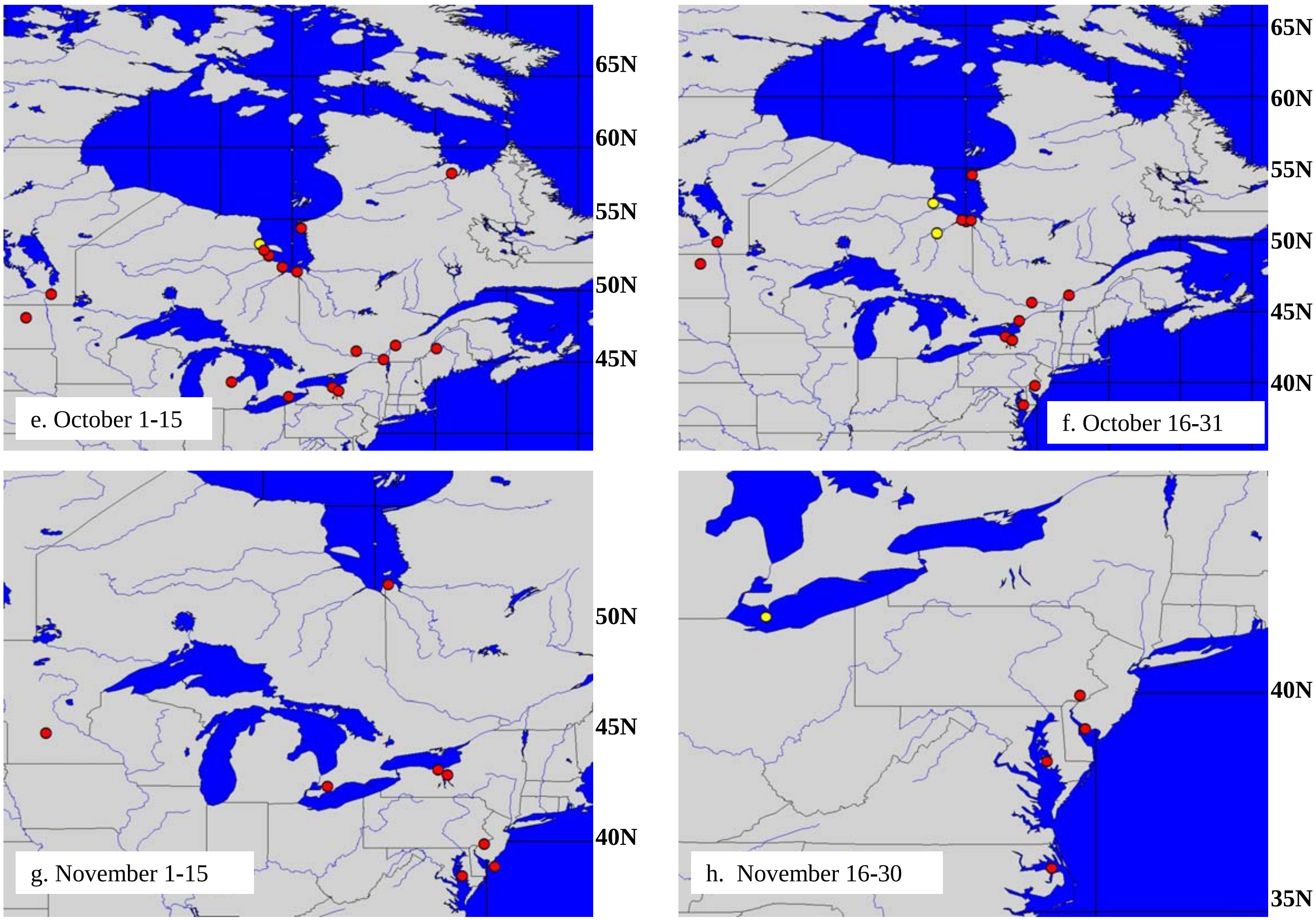

Figure 13 (continued).

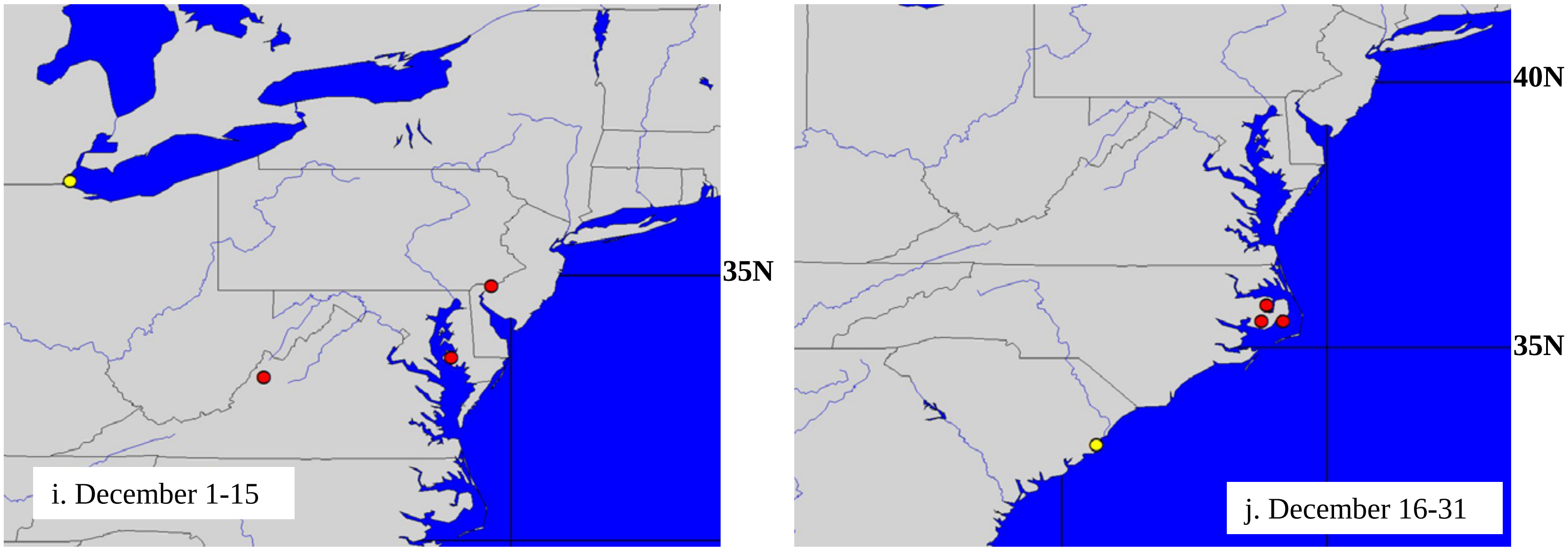

Figure 13 (continued).

Habitat Affiliations

Bird Conservation Regions

We identified 16 BCRs used by pintails during the spring through fall migration, 2003-2005 (Fig. 14). Moving from southern latitudes north, these included: Peninsular Florida, Southeastern Coastal Plain, Piedmont, Appalachian Mountains, Central Hardwoods, Eastern Tallgrass Prairie, New England/Mid-Atlantic Coast, Lower Great Lakes/St. Lawrence Plain, Prairie Hardwood Transition, Prairie Potholes, Boreal Hardwood Transition, Atlantic Northern Forest, Boreal Softwood Shield, Boreal Taiga Plains, Taiga Shield and Hudson Plains, and Arctic Plains and Mountains. The winter range was contained within 3 of these regions: Peninsular Florida, Southeastern Coastal Plain, and New England/Mid-Atlantic Coast.

For birds migrating east of the Great Lakes, the primary ecological zone used prior to reaching northern Canada was the Lower Great Lakes/St. Lawrence Plain. About 60% of all spring locations occurred in this habitat (Table 3). For pintails migrating west of the Great Lakes (Table 4), the Prairie Potholes BCR received the highest use (23% of locations), with birds frequenting the Lower Great Lakes/St. Lawrence Plain (18%) and Eastern Tallgrass Prairie (13%) enroute to this area. During June-July, most bird locations were within the Taiga Shield and Hudson Plains (64-65%) and Arctic Plains and Mountains (22-25%). In fall, both the Taiga Shield and Hudson Plains (54%) and Lower Great Lakes/St. Lawrence Plain (20%) contained the majority of birds prior to returning to the winter range.

Figure 14. Bird Conservation Regions used by northern pintails marked with satellite-tracked transmitters in the Atlantic Flyway, 2003-2005.

Table 3. Primary Bird Conservation Regions used by eastern-migrating pintails during the spring (March-May), summer (June-July), and fall (August-December), 2003-2005.

	#Birds(%)				#Locations(%)			
	2003	2004	2005	Totals	2003	2004	2005	Totals
Spring								
L. Great Lakes/St. Lawrence Plain	2(100)	23(92)	16(94)	41(93)	13(81)	146(57)	168(59)	327(58)
Summer								
Arctic Plains and Mountains	1(100)	2(11)	5(45)	8(27)	10(100)	12(6)	70(44)	92(25)
Taiga Shield and Hudson Plains	0(0)	17(94)	8(73)	25(83)	0(0)	168(86)	71(44)	239(65)
Fall								
L. Great Lakes/St. Lawrence Plain	0(0)	5(50)	4(80)	9(56)	0(0)	28(19)	26(23)	54(20)
Taiga Shield and Hudson Plains	1(100)	8(80)	4(80)	13(81)	9(64)	69(48)	69(61)	147(54)

Table 4. Primary Bird Conservation Regions used by western-migrating pintails during the spring (March-May) and summer (June-July), 2003-2005.

	#Birds(%)				#Locations(%)			
	2003	2004	2005	Totals	2003	2004	2005	Totals
Spring								
L. Great Lakes/St. Lawrence Plain	3(75)	4(67)	1(100)	8(73)	8(17)	18(20)	3(14)	29(18)
Eastern Tallgrass Prairie	3(75)	3(50)	1(100)	7(64)	8(17)	12(13)	1(5)	21(13)
Prairie Potholes	3(75)	4(67)	1(100)	8(73)	8(17)	16(17)	13(62)	37(23)
Summer								
Arctic Plains and Mountains	1(25)	2(40)	1(100)	4(40)	1(3)	12(26)	5(71)	18(22)
Taiga Shield and Hudson Plains	4(100)	4(80)	1(100)	9(90)	19(66)	32(68)	2(29)	53(64)

Specific Geographic Areas

We identified specific geographic areas where pintail locations were clustered for birds migrating both east (Fig. 15) and west (Fig. 16) of the Great Lakes. Within the winter range, locations of eastern-migrating pintails were clustered within and adjacent to Merritt Island National Wildlife Refuge (NWR) in Peninsular Florida, the Albemarle-Pamlico Peninsula in North Carolina, and the Chesapeake-Delaware Bay regions in Delaware, Maryland, Virginia, and New Jersey (Fig. 17). Significant wintering sites within North Carolina include Currituck, Mackay Island, Pea Island, Alligator River, Pocosin Lakes, and Mattamuskeet NWRs, and state waterfowl management areas including the Goose Creek and J. Morgan Futch Game Lands. Within the Chesapeake Bay region of Virginia, Back Bay and Chincoteague NWRs, and the Princess Anne and Hog Island Wildlife Management Areas (WMAs) provide habitat for wintering pintails. Locations were also scattered along coastal drainages of the Pamunkey and James Rivers. Significant sites along Maryland's Eastern Shore include the Blackwater NWR. Locations were clustered in Delaware along the western side of Delaware Bay, particularly within and adjacent to the Prime Hook and Bombay Hook NWRs, and north into the Delaware River estuary to Supawna Meadows NWR in New Jersey and John Heinz NWR at Tinicum in Pennsylvania. Also in New Jersey were locations at Cape May and Edwin B. Forsythe NWRs. The northern winter range also served as a staging area for pintails instrumented in Florida, South Carolina, and North Carolina. Pintails migrating west of the Great Lakes showed a higher affinity for wintering locations in South Carolina, including Santee NWR on the north shore of Lake Marion, and the Santee Coastal Reserve WMA.

Prior to moving into Newfoundland, Labrador, northern Quebec, and the Hudson and James Bay coasts of Ontario, Manitoba and Quebec (collectively Hudson Bay lowlands), pintails migrating east of the Great Lakes staged primarily from the northeastern shore of Lake Erie, east through the Finger Lakes and southern Lake Ontario plain in New York, then northeast through the St. Lawrence River lowlands extending through New York, southeastern Ontario, and southwestern Quebec (Fig. 18). Locations were clustered in southcentral Ontario along the northeastern shore of Lake Erie in the area of Long Point, which includes the Long Point and Big Creek National Wildlife Areas (NWAs), and

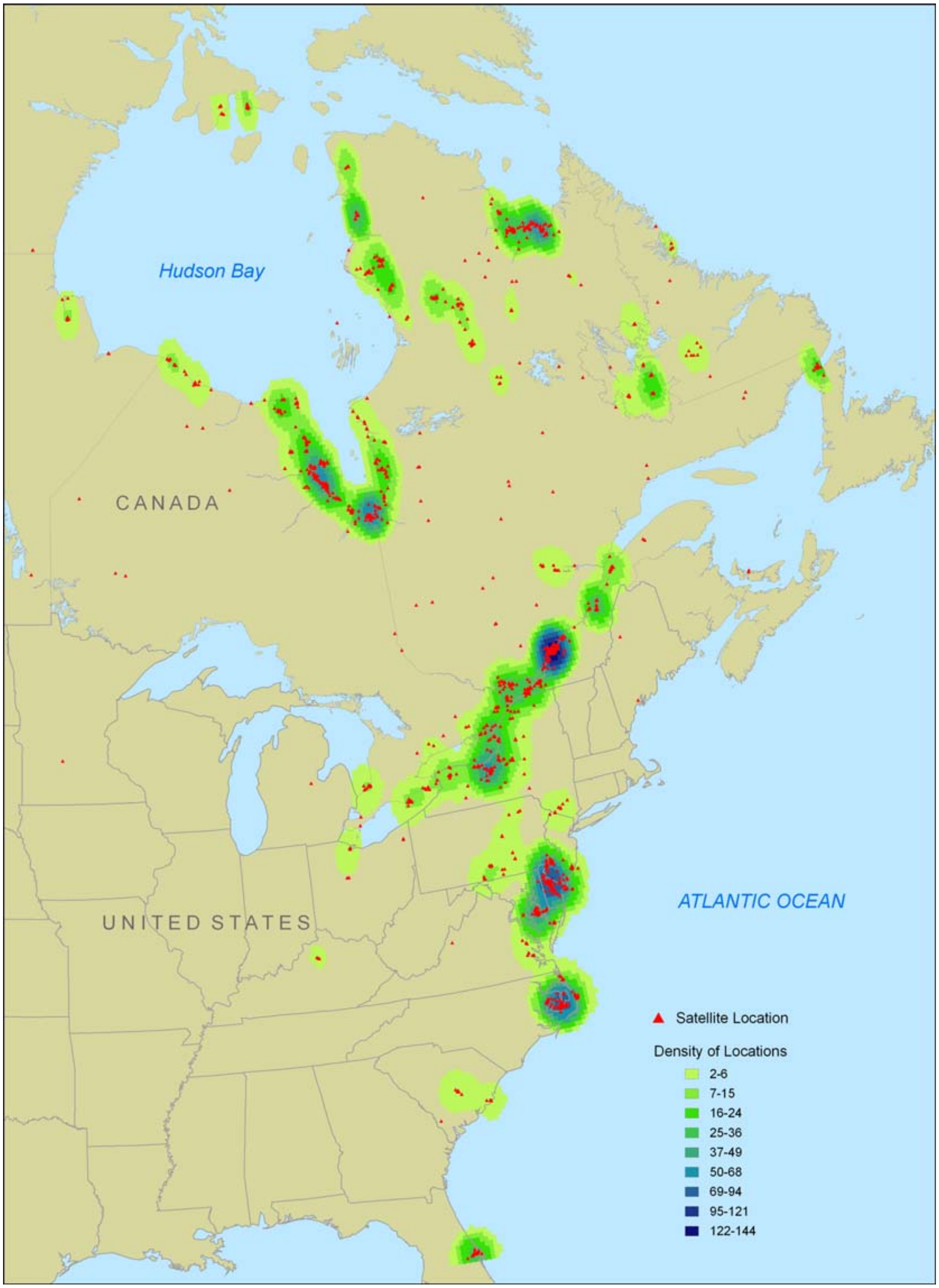

Figure 15. Density of locations throughout the annual cycle, 2003-2005, from satellite-tracked pintails that used the eastern migration corridor during spring.

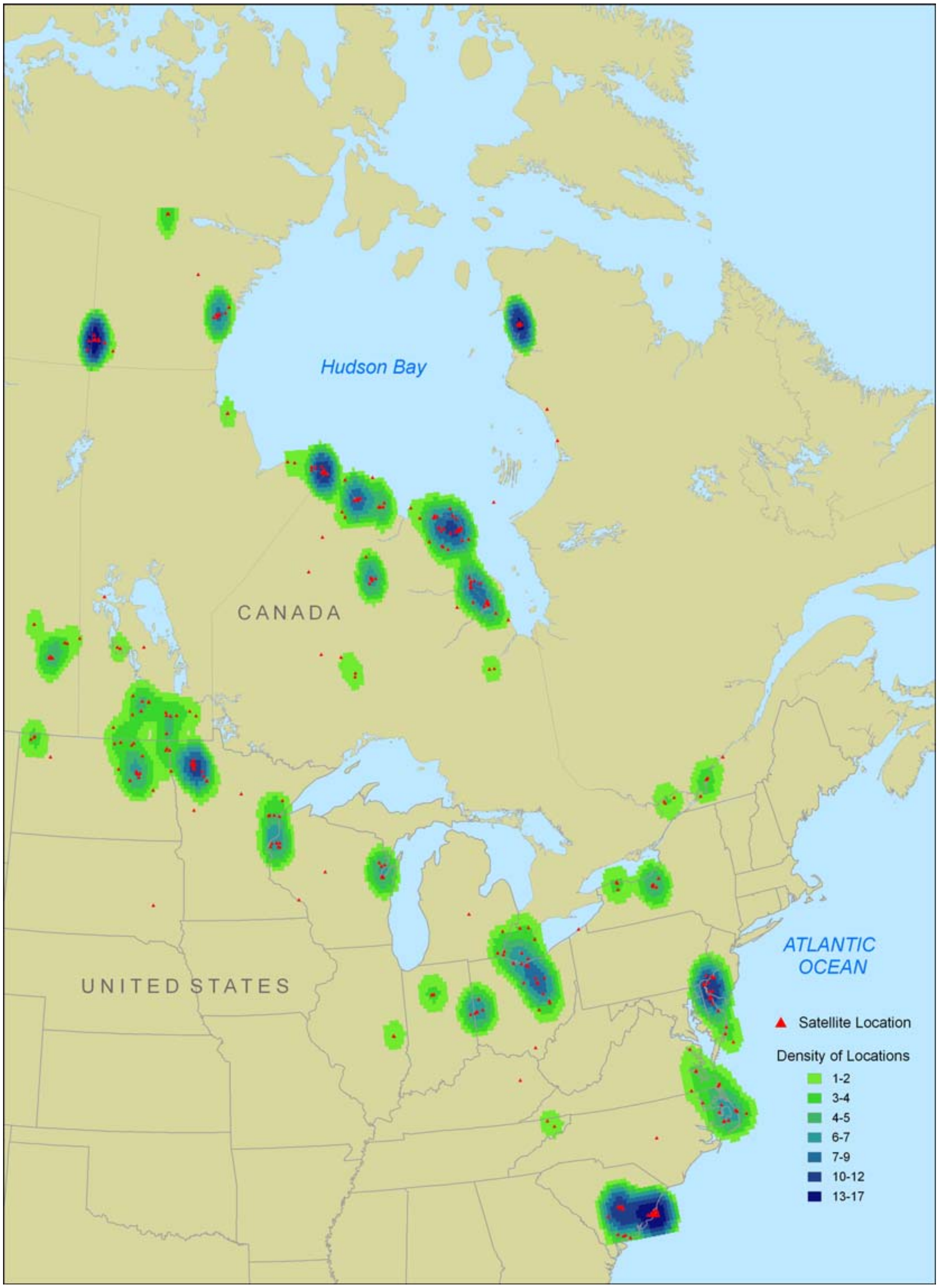

Figure 16. Density of locations throughout the annual cycle, 2003-2005, from satellite-tracked pintails that used the western migration corridor during spring.

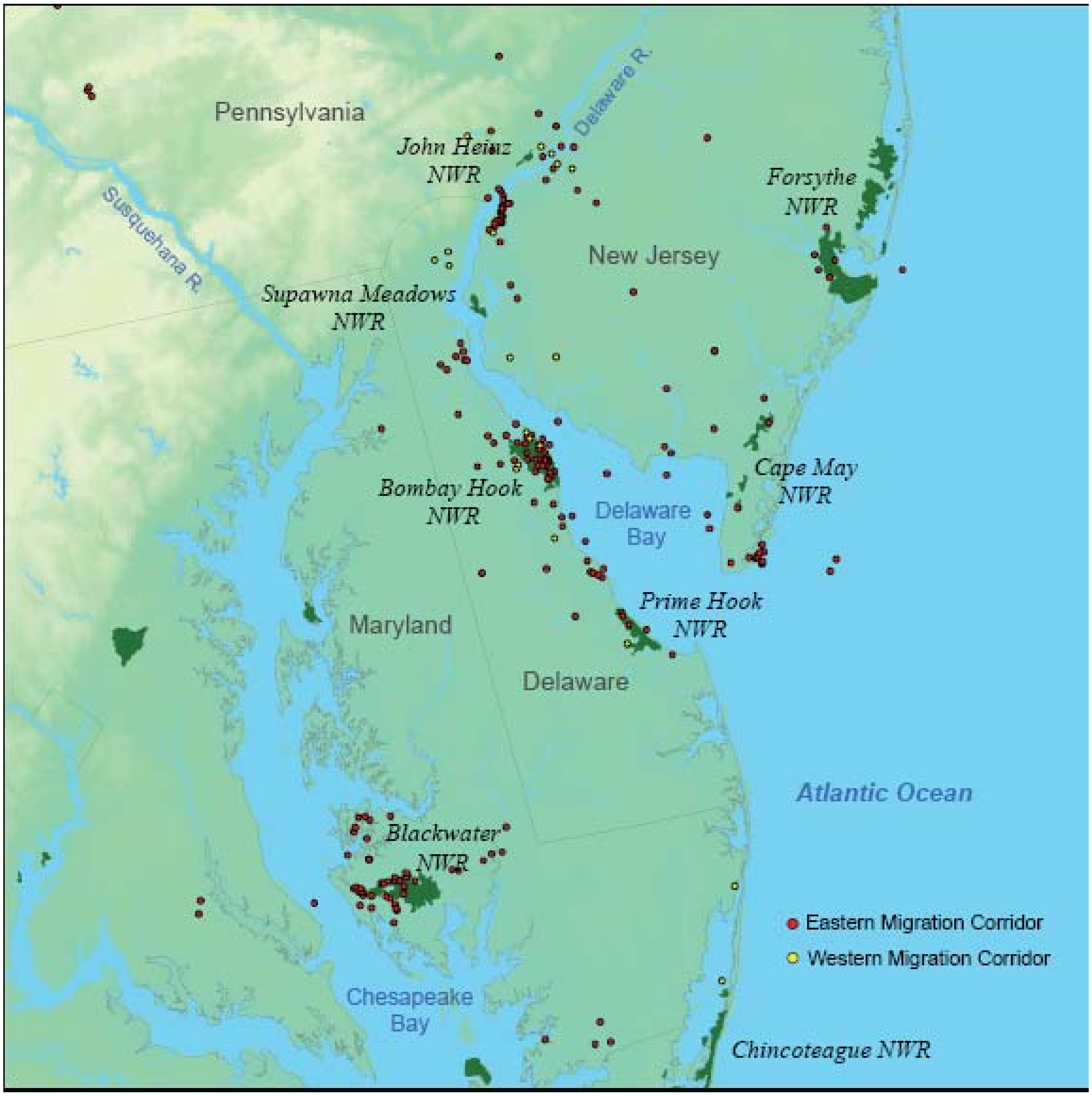

Figure 17. Locations of satellite-tracked pintails in the Chesapeake Bay-Delaware Bay region, 2003-2005.

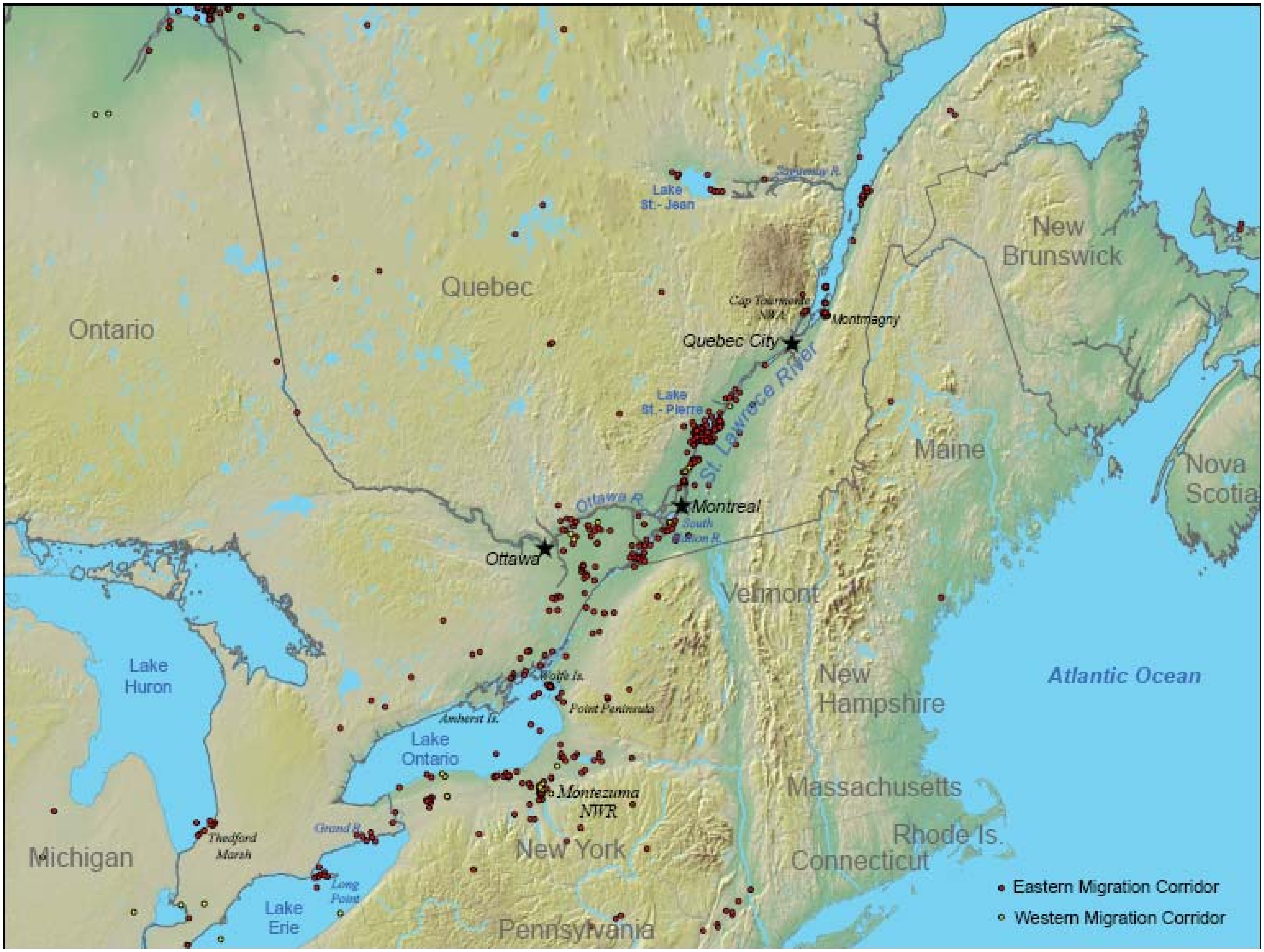

Figure 18. Locations of satellite-tracked pintails in the St. Lawrence River region, 2003-2005.

adjacent to the mouth of the Grand River, which includes the Dunville marshes. Montezuma NWR within the Finger Lakes region of New York was a focal point for locations south of Lake Ontario. Moving from Lake Ontario into the St. Lawrence River, locations were at Wolfe and Amherst Islands in Ontario, and Point Peninsula in New York. In southeastern Ontario, pintails were located throughout the Ottawa River Valley in association with its many tributaries, including the area surrounding the South Nation River, and on the St. Lawrence River between Morrisburg and Cornwall. In Quebec, significant numbers of locations extended along the St. Lawrence River from Lake St. Francis to Montreal. The highest densities of locations along the entire St. Lawrence River and associated lowlands occurred within the Lake St. Pierre floodplain in southwestern Quebec. Locations northeast of Quebec City included the Cap Tourmente NWA and Montmagny on the St. Lawrence River and north, adjacent to Lake St. Jean and the Saguenay River.

Locations of pintails migrating north and west towards the prairie potholes were more dispersed. However, the density of locations indicated stopover sites were located in north central Ohio north to western Lake Erie, western Ohio west into north central Indiana, northeastern Wisconsin adjacent to Lake Michigan, and the border area of northeastern Wisconsin and eastern Minnesota. In Ohio, notable pintail locations were the Funk Bottoms State Wildlife Area (SWA) in north central Ohio, the confluence of the Sandusky River and Lake Erie, and within the Lake Erie marshes at the Ottawa NWR and adjacent Magee Marsh SWA. In Wisconsin, pintails were located within and surrounding the Green Bay Shores SWA on Lake Michigan, and the Fish Lake, Crex Meadows, and Amsterdam Sloughs SWAs in northwestern Wisconsin east of the St. Croix River.

Locations of pintails within the prairie potholes were located from northwestern Minnesota east to north central North Dakota, and north into southern Manitoba and southeastern Saskatchewan. The highest densities of locations were centered on the Agassiz NWR in Minnesota, located in the transition zone between the coniferous forests, tall grass prairie, and the prairie potholes of the Red River Valley, and in North Dakota just east and north of Devils Lake. Locations were more dispersed in Manitoba in the area south of Lake Manitoba east to Winnipeg, and in Saskatchewan in an area roughly centered on Good Spirit Lake Provincial Park.

Summer locations of pintails originating from both eastern and western migration corridors showed strong affinities for the Hudson Bay lowlands (Fig. 19). However, the geographic distribution of pintail locations in this region was different for eastern versus western migrating birds. Locations of eastern-migrating birds were concentrated within the James Bay lowlands from Cape Henrietta Maria, south to Hannah Bay, and north along the coast to Pointe Louis-XIV. Significant concentrations of pintail locations occurred within the Polar Bear Provincial Park, Akiminski Island, including the Akiminski Island Migratory Bird Sanctuary, the coastline from Attawapiskat south to the Albany River estuary, and Hannah Bay including the Hannah Bay Migratory Bird Sanctuary. Locations of western-migrating pintails were clustered near Cape Tatnum in Manitoba, the Severn River and Ontario coastline, inclusive of the Polar Bear Provincial Park, Akiminski Island and western James Bay shoreline to the Albany River estuary.

Locations of eastern-migrating pintails moving into northern Quebec were clustered along the southern Ungava Bay coast, particularly east and west of the Koksoak River at Kuujjuaq, along the eastern coast of Hudson Bay on the Ungava Peninsula, and south of the Ungava Peninsula in the interior region from Lake Minto south to Lake Saindon. Other notable locations were in central Labrador near Happy Valley–Goose Bay, and in southwestern Labrador near the Smallwood Reservoir. More isolated are locations from single birds in Labrador at the Strait of Belle Isle near the Brador Bay Migratory Bird Sanctuary, and at South Hampton Island in the Northwest Territories. Only 1 western-migrating pintail reached the Ungava Peninsula in northern Quebec. Other dispersed locations included those in the Keewatin and Mackenzie districts of the Northwest Territories, north of 60º N Latitude.

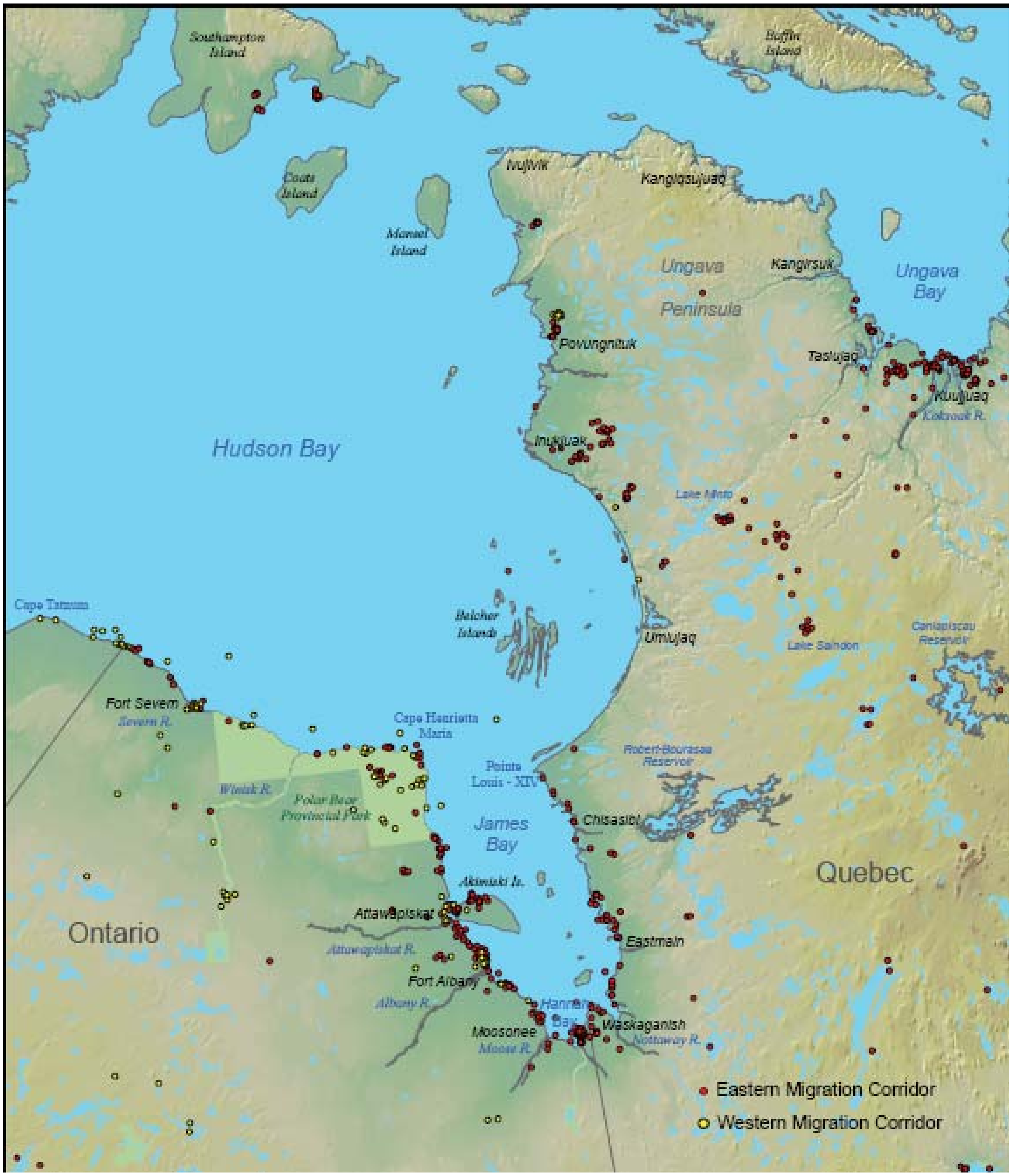

Figure 19. Locations of satellite-tracked pintails in the Hudson Bay-James Bay region, 2003-2005.

DISCUSSION

We began this project in 2003 as a pilot study to evaluate the feasibility of monitoring the movement of female pintails using 30-g satellite PTTs and harness attachments. We did not weigh birds the first year knowing that our transmitter exceeded the conventional standard of ~3-4% of the bird's body weight. We also had difficulty trapping pintails, which limited our selection with respect to age and weight. However, we had experience in marking birds with satellite-tracked transmitters and felt that our harness design, modeled after that originally used to successfully track peregrine falcons (*Falco peregrinus*) with 30-g satellite transmitters in the 1990s, would overcome these limitations. The 10 birds marked in 2003 responded well. Six transmitted for >180 days with some individuals traveling >3,000 km. Additional marking in 2004 and 2005 with lighter 20-g PTTs and selection for heavier females improved success, especially during the first 3 months after release. However, the average longevity of transmitters over the entire study (169 days) was not appreciably different from the average for the 2003 birds.

Transmitter failure is a possible reason for not obtaining a satellite signal, but mortality of the hen is also an important consideration. Natural mortality, in the form of predation, can be prevalent in females during the nesting- and brood-rearing period. We do not know how many of our transmittered birds attempted to nest or the cause of any transmitter failures that occurred during the breeding season. The same is true for the post-breeding period. However, we do know that all birds undergo a feather molt during the post-breeding period. Hohman et al. (1992:128) describe the post-breeding period "as that segment of the annual cycle of migratory waterfowl bracketed by the reproductive and fall migration periods. It closely follows peak metabolic investments in reproduction and is characterized by a substantial commitment of energy and nutrients to somatic production (i.e., feather growth)". Lower levels of lipids and proteins can result in a fairly dramatic shift in the proportion of total body weight attributed to the PTT and harness, adding substantially to a hen's energetic demands. For comparison, in the late 1990s, 34 female Canada geese similarly fitted with 30-g PTTs programmed at comparable transmission intervals were monitored an average of 315 days (Malecki et al. 2001). The larger size and higher survival of this species likely contributed to the longevity of the tracking period.

Spring migration patterns from this study were not unlike recovery distributions plotted for northern pintails banded in the Atlantic Flyway during winter, 1965-2004. There appears a strong component of birds moving east of the Great Lakes and a lesser-used corridor to the west. How this distribution pattern relates to numbers of birds, or whether shifts in the proportion of birds using these corridors have occurred over time, is unknown. What we have learned from 4 years of satellite tracking, compared to 40 years of band-recovery data, enhances our understanding of how pintails move between wintering and breeding areas. Although satellite-telemetry data are derived from a much smaller sample of birds captured and marked, they are the only source of information on distributions in remote locations that are not frequented by hunters.

Bellrose (1976: 270-271) describes the pintail as " the most paradoxical of ducks in its seasonal migration - it is one of the first ducks to migrate south in the fall, yet one of the first ducks to migrate north in the spring. It tends to have a more protracted fall passage and a shorter spring passage than other species." He then describes spring migration of pintails as commencing in late January/early February and continuing through March. By mid- to late March most pintails have left the winter range and are peaking in numbers at middle latitudes. Arrival of pintails on the Northern Plains of the United States begins in early April with peak populations occurring by mid-April before large numbers migrate still farther north.

In this study, pintail hens displayed the early spring migrations described by Bellrose, but the duration of their spring migration was more extended. A major staging area for females migrating though the eastern corridor occurred near Delaware Bay at the northern end of the winter range. In 2004, nearly 28,000 pintails were observed on 27 February during an aerial survey of tidal salt and brackish water marshes in southern New Jersey (T. Nichols, NJ Div. Fish and Wildlife, pers. commun.). On 9 March, fewer than 5,000 were seen in the same areas. Subsequent movements of pintails appeared very similar to those shown for Atlantic Population (AP) Canada geese that breed throughout the Ungava Peninsula of northern Quebec (Malecki et al. 2001). The spring movement of geese from their primary winter terminus in the Delaware-Maryland-Virginia (Delmarva) Peninsula of Chesapeake Bay begins in late February and proceeds north favoring pathways up the Susquehanna and Delaware River systems to the Finger Lakes and southern Ontario Lake plains of New York. Like our pintails, a build up of Canada geese occurs in this region through March followed by a shift to the northeast, in this instance toward the Ottawa River Valley, in April. This is followed by dispersal to northern breeding areas in early May. Mean nest initiation for Canada geese in northern Quebec occurs ~May 26th; the long-term average for 1997-2006 (R. Cotter, Canadian Wildlife Service, pers.comm.). The striking similarity in early May staging and dispersal to northern breeding areas of both Canada geese and pintails suggests that the 2 species are using similar photoperiod and/or environmental cues. This also suggests that a number of female pintails are breeding at latitudes similar to AP geese throughout eastern Canada.

Pintail hens migrating west of the Great Lakes appeared more similar in their temporal patterns to that described by Bellrose (1976). Migration from the winter range was initiated prior to March followed by a build up at middle latitudes south of the Great Lakes. However, unlike Bellrose's description of peak populations building on the prairie-pothole regions of the Northern Plains by mid-April, only 5 of 11 of our birds were there at this time; the majority being present by late April. Birds then dispersed north from this region in mid- to late May.

Miller et al. (2003) tracked female pintails from wintering locations in California, New Mexico, Texas, and Mexico. They felt that birds showing fidelity to northern nesting regions could be identified by their migration strategy. For example, pintails nesting in Alaska tended to start the trip with long non-stop migrations, while birds going to the prairie nesting regions flew north on a more leisurely schedule making greater use of stopover sites. This latter scenario seems applicable to eastern pintails that migrated to the prairies. A number of these birds also stayed in the prairie region through mid-May, which suggests a nesting affiliation given that this is the primary breeding area for pintails in North America.

Spring movement of pintail hens through eastern Canada, as it relates to potential nesting activity, was more difficult to assess. Our data, and data described by Bellrose (1976) and Palmer (1979), suggests that some birds nest along the St Lawrence River drainage and as far east as Newfoundland, but their numbers are not large. In New York, the pintail is considered a “rare and local” breeder (Andrle and Carroll 1988) and few pintails are reported during the spring aerial surveys conducted for ducks throughout eastern Canada (M. Koneff, USFWS, pers. commun.).

The majority of our marked birds moved to northern latitudes at the fringe of the boreal forest and beyond. Nesting of pintails at these latitudes has long been confirmed (Bellrose 1976, Palmer 1976), but little, if any, information is available concerning productivity. Although pintails are known for their ability to nest in Arctic habitats, colder ambient temperatures with greater potential for inclement weather, limited food at the time of nesting, and the utilization of stored reserves to handle these conditions and reproductive costs should relate to smaller clutch sizes, lower nest success, and overall lower productivity. Sheaffer et al. (1999) found evidence for this in their development of continental recruitment models for northern pintails. After extensive consideration of many parameters, they found that latitude and pintail breeding population estimates (BPOP) were the most important predictors of recruitment. Runge and Boomer (2005) recently improved this model by making recruitment a function of the latitude of the center of the breeding population distribution, the variance of that mean latitude, and the ratio of the population size in northern versus southern strata. In years when the distribution of breeding pintails is centered at a higher latitude, recruitment decreases, all other things being equal. They also concluded that the continental carrying capacity for pintails likely has declined in recent years due to a gradual northward shift in the distribution of breeding pintails.

Movement of pintails, in June and July, primarily occurred east of the Manitoba/Ontario border along Hudson Bay. This distribution of eastern pintails is in sharp contrast to females tracked by Miller et al. (2003). Their pintails showed a strong affiliation in their spring and summer movements to locations west of Hudson Bay to Alaska. However, the focus of their study was on spring movement of female pintails, and fewer birds, especially from wintering locations in the Central Flyway, were monitored through the summer.

Clustering of pintails in eastern sub-arctic coastal habitats and inland water bodies could reflect areas used for both nesting and feather molt. About 25 or more days are needed during the molt to grow primaries suitable to attain flight (Miller et al. 1992). The timing of the molt can vary between successful breeders, unsuccessful breeders, and females that did not attempt to nest. Successful hens often remain near brood rearing areas (Salomonsen 1968), but these areas could also be used for molting by hens without young. We did not attempt to isolate the time spent by individuals in each cluster because of the variability associated with the 5-day interval between PTT transmissions.

Fall movement south from the summer range was not rigorously defined by our small sample, but there was evidence of birds staging in southern Ontario/Quebec and northern New York prior to movement farther south. Birds continued to collect in this region during September and October where they remained until mid-October. High immature:adult ratios in the harvest of pintails in eastern Canada could reflect a longer stay of birds in this heavily populated region during the peak of the duck hunting season. The increase in the proportion of the eastern pintail harvest seen in New York could also be related to extended use of this region in fall and the longer season length of 60 days. However, it could also reflect improvements in habitat, or a change in the proportional distribution of the flyway pintail harvest derived from pintails transiting eastern versus western migration corridors. The same is true for declines in the proportion of the pintail harvest seen in New Jersey, Florida, and South Carolina. For southern states, harvest seasons both within and outside the Atlantic Flyway, due to greater affiliation of birds to the mid-continent regions, are potential factors. Bethke and Nudds (1995) and Miller and Duncan (1999) believe the conversion of grasslands to small-grain agriculture, especially in western Canada, has reduced or eliminated much of the safe upland nesting habitat for pintails and other dabbling ducks species.

One aspect of eastern pintail population dynamics that remains an enigma is the consistently higher immature:adult ratios in eastern harvests compared with the western provinces of Canada. Eastern pintails nest at latitudes higher than the more temperate latitudes of the prairie-pothole region where productivity is considered optimal. Although consistently high age ratios in the harvest could reflect an unknown aspect of harvest dynamics and not productivity, it could also reflect a level of stability in the breeding areas used by eastern pintails that favors a relatively high rate of annual production. If this were not the case, years of poor production attributed to late spring climatic conditions in eastern Canada should be reflected in lower numbers of young observed at least occasionally in the harvest. To date, harvest statistics have suggested consistently high proportions of young in the harvest, and pintails in eastern North America maintain relatively stable numbers in both the hunter harvest and midwinter surveys.

MANAGEMENT IMPLICATIONS

Adaptive harvest management (AHM) of waterfowl, which provides a framework for making objective management decisions in the face of uncertainty regarding the many variables that affect waterfowl population dynamics (Williams and Johnson 1995), is currently implemented by the USFWS for harvest management of mid-continent mallards. Model sets for eastern mallards (Sheaffer and Malecki 1996) were incorporated into the AHM process in 2000 based on differences in their breeding ground derivations and recruitment. Model sets for pintails have also been developed and currently are being tested under an interim harvest strategy. AHM models have been explored for other species, such as American black ducks (*A. rubripes*), wood ducks (*Aix sponsa*), canvasbacks (*Aythya valisineria*), and AP Canada geese, but for most species and even sub-sets of large stocks, such as eastern pintails and western mallards, too little information exists on which to model their dynamics.

North American duck populations generally are exposed to (1) a common hunting season based on criteria established for mallards, and (2) somewhat arbitrary species-specific restrictions based on efforts to account for variation in their ability to support harvest without adverse impacts. As noted by the U.S. Fish and Wildlife (2003:22), "..stock-specific harvest returns and population trajectories are subject to considerable uncertainty, whose sources include uncontrolled environmental variation, random effects of regulation (i.e., partial controllability), uncertainties in population dynamics, and errors and biases in data-collection programs (i.e. partial observability)." Harvest management of these species is further complicated by variation in the value often placed on certain species or stocks by hunters across the country.

The difficulties in obtaining information on most waterfowl species is not likely to lessen, but resource managers need to constantly improve upon the data needed to make informed management decisions. The data presented on the distribution, movements, and habitat associations of eastern pintails, as well as the questions raised by this study, are a step toward improving the knowledge base for eastern pintails. It is also our intent to both recognize and compliment the great strides made in implementation of the North American Waterfowl Management Program, its Bird Conservation Region initiative, and habitat Joint Ventures, by integrating our results with the products of these programs as they relate to collective use by a regional waterfowl population, the northern pintail in eastern North America.

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APPENDICES

Appendix 1. Number of pintails observed between New Jersey and Florida during the midwinter waterfowl survey in the Atlantic Flyway, 1994-2003 (USFWS 2005*a*).

				State					Atlantic Flyway
Year	**NJ**	**DE**	**MD**	**VA**	**NC**	**SC**	**GA**	**FL**	**Total***
1994	300	1,055	148	1,539	32,531	21,095	0	4,842	61,510
1995	930	2,965	1,997	697	34,931	3,167	90	5,786	50,626
1996	660	0	880	1,719	18,764	6,848	1	5,720	34,606
1997	2,040	11,057	2,340	1,540	17,369	5,888	0	2,887	43,165
1998	2,390	6,184	1,805	1,137	26,104	5,046	32	2,663	45,419
1999	2,725	942	3,781	1,930	42,583	5,738	73	7,454	65,259
2000	2,350	2,700	5,422	1,775	16,744	3,583	0	5,303	37,890
2001	1,595	52	2,837	894	33,345	5,605	31	3,540	47,902
2002	8,245	1,330	1,777	2,050	24,785	4,037	1	5,828	48,139
2003	3,600	2,050	1,349	820	17,418	8,140	210	2,737	36,324
Mean	2,483	2,833	2,233	1,410	26,457	6,914	44	4,676	47,084
%Total	5%	6%	5%	3%	56%	15%	Tr	10%	

* All 17 Atlantic Flyway states included.

Appendix 2. Number of pintails observed during the midwinter waterfowl survey in the Atlantic Flyway (USFWS 2005*a*).

YEAR	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE	MD	VA	NC	SC	GA	FL	AF TOTAL
1955	0	0	0	5	0	0	207	12,036	1	23,511	1,792	55,978	4,700	36,605	90,000	325	215,160	440,320
1956	6	0	0	1	0	0	212	1,781	14	5,030	3,929	60,111	18,100	25,494	113,135	110	228,393	456,316
1957	0	0	0	13	16	0	218	103	100	3,765	463	46,400	6,200	14,700	107,300	100	36,900	216,278
1958	0	0	0	29	0	0	0	368	100	5,294	1,661	13,900	2,461	39,660	77,825	250	39,558	181,106
1959	0	0	0	0	0	9	350	175	0	3,310	131	7,800	2,400	15,000	99,300	1,600	59,300	189,375
1960	0	0	0	0	0	17	58	427	0	4,162	13,089	13,800	3,300	25,200	115,000	200	22,200	197,453
1961	3	0	0	0	0	0	172	69	0	284	9,809	10,800	5,700	29,100	112,100	400	46,900	215,337
1962	0	0	0	0	0	0	300	200	0	600	21,800	9,700	3,400	22,300	74,200	500	43,500	176,500
1963	0	0	0	0	0	0	0	0	0	800	500	3,200	11,150	45,900	99,400	350	20,400	181,700
1964	0	0	0	0	0	0	0	100	0	500	3,600	2,000	3,200	29,800	101,800	500	29,200	170,700
1965	0	0	0	0	0	0	0	2,000	0	700	3,500	6,700	2,700	24,600	74,200	200	17,800	132,400
1966	0	0	0	0	0	0	0	1,500	0	2,600	4,400	0	1,700	19,200	111,900	200	20,600	162,100
1967	0	0	0	0	0	0	0	700	0	2,300	4,800	11,100	21,200	39,900	74,500	400	16,100	171,000
1968	0	0	0	0	0	0	0	300	0	800	100	2,100	7,400	46,200	70,800	200	6,200	134,100
1969	0	0	0	0	0	0	0	0	0	800	100	13,100	9,500	45,800	43,200	600	18,400	131,500
1970	0	0	0	0	0	0	0	100	0	1,700	0	400	0	45,100	82,500	200	12,300	142,300
1971	0	0	0	0	0	0	0	0	0	1,100	300	2,200	600	40,600	81,800	300	6,700	133,600
1972	0	0	0	0	0	0	0	300	0	1,600	100	1,400	4,900	22,800	62,600	0	14,100	107,800
1973	0	0	0	0	0	0	0	100	0	400	0	400	3,100	24,100	41,000	200	8,700	78,000
1974	0	0	0	0	0	0	0	0	0	900	2,900	1,200	3,700	41,200	14,700	0	6,200	70,800
1975	0	0	0	0	8	0	26	25	2	2,200	1,785	200	4,200	31,800	20,300	100	11,600	72,246
1976	0	0	0	0	0	0	2	2,084	0	1,700	3,780	700	7,825	53,500	13,500	800	8,600	92,491
1977	0	0	0	0	15	0	0	219	0	400	210	600	1,250	61,400	21,800	100	20,400	106,394
1978	0	0	0	0	60	0	0	1,014	0	700	133	100	2,700	49,800	17,500	200	13,400	85,607

YEAR	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE	MD	VA	NC	SC	GA	FL	AF TOTAL
1979	0	0	0	0	0	0	35	283	0	1,450	663	1,100	5,340	33,200	15,700	200	14,100	72,071
1980	0	0	0	0	15	0	65	314	0	3,755	793	800	5,950	21,800	10,600	100	10,300	54,492
1981	0	0	0	0	5	0	0	115	0	950	38	400	2,504	36,800	11,800	1,300	14,050	67,962
1982	0	0	0	0	0	0	0	400	0	5,200	0	0	6,200	32,400	18,300	100	6,300	68,900
1983	0	0	0	0	100	0	0	200	0	3,900	1,200	200	4,400	15,200	14,000	100	8,800	48,100
1984	0	0	0	0	0	0	0	300	0	800	0	0	1,500	15,700	17,700	0	10,200	46,200
1985	0	0	0	0	0	0	0	100	0	2,200	1,800	100	2,300	15,700	7,200	0	4,600	34,000
1986	0	0	0	0	0	0	0	0	0	600	800	0	1,000	21,000	17,900	0	6,100	47,400
1987	0	0	0	0	0	0	0	100	0	2,100	400	300	1,200	13,400	17,400	100	1,900	36,900
1988	0	0	0	0	0	0	100	0	0	2,000	0	100	335	12,400	13,500	300	7,500	36,235
1989	0	0	0	5	0	0	1	300	0	3,200	1,080	41	3,119	21,382	16,024	220	9,721	55,093
1990	0	0	0	0	0	0	0	100	0	2,100	50	462	711	18,162	13,882	160	8,368	43,995
1991	0	0	0	0	0	0	66	5	0	6,600	15,600	885	1,685	18,093	13,896	60	12,047	68,937
1992	0	0	0	66	1	0	10	2	0	2,030	820	2,588	1,028	15,338	14,689	59	6,074	42,705
1993	0	0	0	10	0	0	0	3	38	915	3,275	837	3,028	27,205	11,187	55	4,821	51,374
1994	0	0	0	0	0	0	0	0	0	300	1,055	148	1,539	32,531	21,095	0	4,842	61,510
1995	0	0	0	0	0	0	15	0	6	930	2,965	1,997	697	34,973	3,167	90	5,786	50,626
1996	0	0	0	0	0	0	14	0	0	660	0	880	1,719	18,764	6,848	1	5,720	34,606
1997*	0	0	0	0	0	0	32	12	0	2,040	11,057	2,340	1,540	17,369	5,888	0	2,887	43,165
1998	0	0	0	0	0	0	39	13	6	2,390	6,184	1,805	1,137	26,104	5,046	32	2,663	45,419
1999	0	0	0	0	0	0	1	2	30	2,725	942	3,781	1,930	42,583	5,738	73	7,454	65,259
2000**	0	1	0	0	0	0	0	12	0	2,350	2,700	5,422	1,775	16,744	3,583	0	5,303	37,890
2001**	2	0	0	0	0	0	0	0	1	1,595	52	2,837	894	33,345	5,605	31	3,540	47,902
2002	0	0	0	35	0	0	2	6	43	8,245	1,330	1,777	2,050	24,785	4,037	1	5,828	48,139

YEAR	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE	MD	VA	NC	SC	GA	FL	AF TOTAL
2003**	0	0	0	0	0	0	0	0	0	3,600	2,050	1,349	820	17,418	8,140	210	2,737	36,324
2004**	10	0	0	1	0	0	0	1	24	1,920	12,462	4,602	1,700	21,452	8,458	3	4,890	55,523
2005**	0	0	0	0	0	0	0	1	20	5,035	806	1,913	1,125	19,661	7,573	9	NS**	36,143
AVERAGES:																		
55-60	1	0	0	8	3	4	174	2,482	36	7,512	3,511	32,998	6,194	26,110	100,427	431	100,252	280,141
61-65	1	0	0	0	0	0	94	474	0	577	7,842	6,480	5,230	30,340	92,340	390	31,560	175,327
66-70	0	0	0	0	0	0	0	520	0	1,640	1,880	5,340	7,960	39,240	76,580	320	14,720	148,200
71-75	0	0	0	0	2	0	5	85	0	1,240	1,017	1,080	3,300	32,100	44,080	120	9,460	92,489
76-80	0	0	0	0	18	0	20	783	0	1,601	1,116	660	4,613	43,940	15,820	280	13,360	82,211
81-85	0	0	0	0	21	0	0	223	0	2,610	608	140	3,381	23,160	13,800	300	8,790	53,032
86-90	0	0	0	1	0	0	20	100	0	2,000	466	181	1,273	17,269	15,741	156	6,718	43,925
91-95	0	0	0	15	0	0	18	2	9	2,155	4,743	1,291	1,595	25,628	12,807	53	6,714	55,030
96-2000	0	0	0	0	0	0	17	8	7	2,033	4,177	2,846	1,620	24,313	5,421	21	4,805	45,268
2001-05	2	0	0	7	0	0	0	2	18	4,079	3,340	2,496	1,318	23,332	6,763	51	4,249	44,806

* Estimates for NY based on change in Federation of NY State Bird Club Counts, 1996 to 1997.
** Estimates for some states and the Flyway are not comparable with other years.
2000: Estimates for portions of some states (CT, NY) based on previous 3-year average.
2001: Estimates for portions of FL based on previous 3-year average.
2003: Florida data are incomplete. Data from the USFWS Redhead Survey areas are unavailable.
2004: No survey conducted in Florida. Estimates for Florida based on 2000-2002 average.
2005: No survey conducted in Florida.

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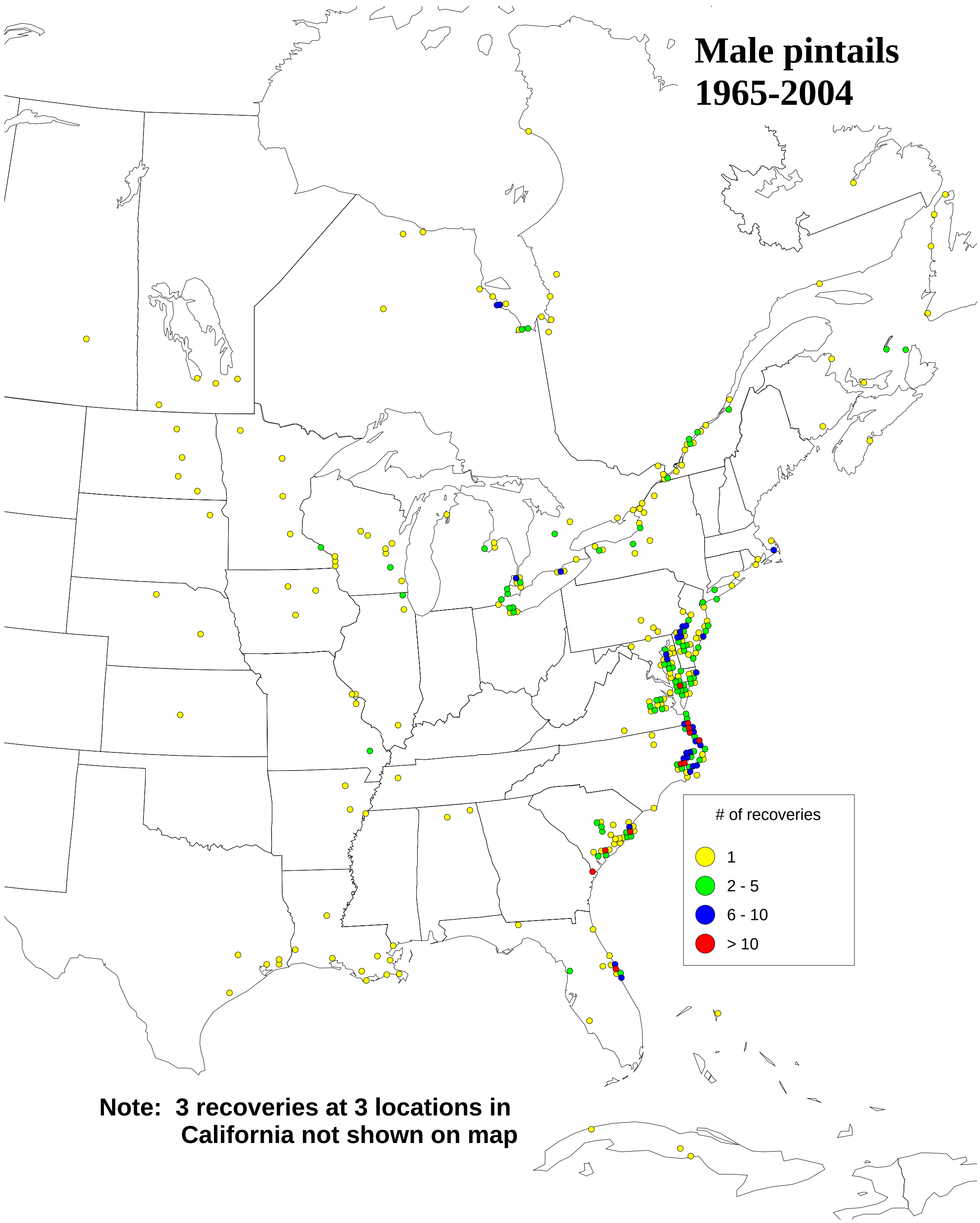
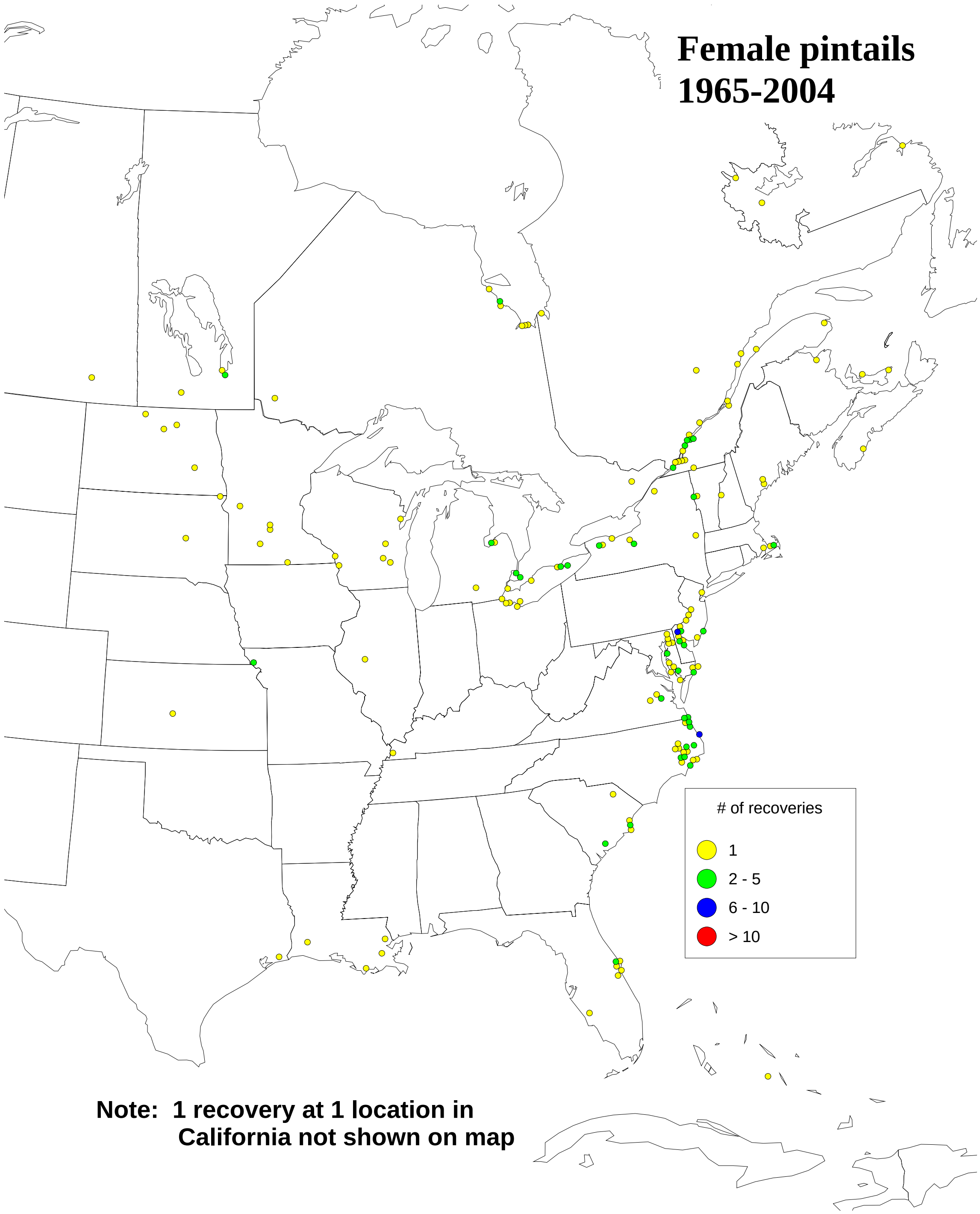
Appendix 3. **Locations of band recoveries from pintails banded during winter (January – March) in the Atlantic Flyway, 1965-2004. Recoveries were reported to the USGS Bird Banding Lab as shot or found dead. Number of birds banded totaled 11,820: New England states = 158, NY = 93, PA = 704, NJ = 490, MD = 1,816, DE = 115, VA = 190, WV = 5, NC = 5,166, SC = 1,899, GA = 42, FL = 189. Number of recoveries totaled 999; most (67%) were reported during 1965-1974, with 26% in 1975-1984, 2.5% in 1985-1994, and 4.5% in 1995-2004.**




Female pintails
1965-2004
# of recoveries
1
2 - 5
6 - 10
> 10
Note: 1 recovery at 1 location in
California not shown on map

Appendix 4. Estimates of regular-season harvest in the Atlantic Flyway based on the USFWS Harvest Information Program (USFWS 2005*a*).

Year	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE	MD	VA	NC	SC	GA	FL	AFTOT
1999	500	600	100	100	200	0	3,500	400	0	1,100	2,800	3,200	1,100	6,700	300	300	4,200	25,200
2000	400	200	100	0	0	0	2,600	400	0	1,500	1,000	4,000	1,400	5,000	1,900	100	2,100	20,800
2001	100	300	0	100	100	100	2,100	600	0	1,300	1,300	3,500	1,400	6,100	400	500	1,400	19,300
2002	600	300	100	100	100	0	4,100	800	0	500	2,400	1,600	1,200	3,300	600	300	1,200	17,100
2003	400	100	100	0	100	0	2,600	200	0	600	2,000	3,200	1,300	4,400	1,400	500	1,100	18,100
2004	200	400	0	0	0	0	1,900	500	0	500	1,600	1,200	900	1,700	300	0	900	10,300
Averages 1999-2000	450	400	100	50	100	0	3,050	400	0	1,300	1,900	3,600	1,250	5,850	1,100	200	3,150	23,000
2001-04	325	275	50	50	75	25	2,675	525	0	725	1,825	2,375	1,200	3,875	675	325	1,150	16,200

All estimates are preliminary   C:\Data Book\Atlantic\Harvest Estimates\HIP Ducks.xls   Sheet: Revision: 07/11/05   RVR

Appendix 5. Estimates of regular-season harvest in the Atlantic Flyway based on the USFWS Harvest Survey (USFWS 2005*b*).

YEAR	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE	MD	VA	NC	SC	GA	FL	TOTAL
1961	300	400	100	500	200	100	2,000	600	0	1,200	1,000	3,000	1,600	3,100	500	0	1,700	16,300
1962	100	200	0	300	0	0	1,000	900	100	1,300	500	1,600	2,600	3,400	200	100	5,000	17,300
1963	500	400	100	200	0	100	500	900	0	3,600	700	2,100	2,800	4,500	1,600	100	7,400	25,500
1964	500	200	0	100	100	100	1,200	700	0	2,600	1,000	2,600	1,500	3,800	1,800	100	7,700	24,000
1965	400	100	0	100	100	100	1,500	700	0	2,600	500	1,200	1,300	2,700	900	400	7,000	19,600
1966	400	200	100	400	100	100	1,500	1,300	0	2,300	1,400	2,300	2,200	4,000	2,400	100	9,000	27,800
1967	400	200	0	400	300	0	2,800	400	0	2,900	1,700	1,300	2,800	4,300	2,000	300	8,300	28,100
1968	600	400	100	0	0	100	2,200	300	0	2,400	1,100	2,300	3,000	8,400	1,500	100	3,900	26,400
1969	400	300	100	500	300	0	5,800	500	0	2,300	1,600	6,700	5,000	7,200	1,600	200	9,800	42,300
1970	1,600	600	100	800	400	100	5,600	500	0	1,900	2,000	1,600	5,200	7,200	2,800	1,600	14,400	46,400
1971	400	200	100	100	0	0	1,700	1,200	0	4,300	1,200	2,200	1,700	3,500	2,000	500	5,700	24,800
1972	400	300	0	200	100	100	2,200	600	0	1,000	2,400	2,400	2,400	5,700	2,800	600	3,600	24,800
1973	300	300	100	100	0	0	4,100	500	0	1,600	800	4,700	4,400	3,700	4,300	200	2,500	27,600
1974	500	400	600	200	200	100	5,000	1,300	0	5,700	1,300	2,100	4,300	7,900	2,000	400	2,500	34,500
1975	400	0	100	300	200	0	2,600	300	0	10,200	1,600	4,500	6,300	6,400	2,400	800	5,100	41,200
1976	800	500	0	600	400	0	5,400	1,000	0	4,800	800	1,200	3,200	11,200	2,000	300	10,000	42,200
1977	800	500	0	500	500	100	3,100	1,700	0	4,600	1,500	2,000	3,400	9,200	2,500	100	20,200	50,700
1978	400	200	100	100	0	100	2,800	600	0	5,600	1,100	4,100	2,000	4,400	3,500	900	9,900	35,800
1979	200	400	0	400	200	170	4,300	1,400	400	2,500	2,800	5,200	2,100	7,900	13,800	300	6,600	48,670
1980	200	300	100	200	100	200	3,800	400	100	3,300	2,300	2,600	1,500	9,000	5,200	700	8,600	38,600
1981	400	600	0	800	100	300	3,900	700	100	4,300	1,900	1,300	900	5,300	2,100	400	4,800	27,900
1982	700	700	0	200	300	100	3,800	600	100	2,700	1,300	3,900	1,400	17,200	2,200	200	3,200	38,600
1983	400	300	100	100	0	100	2,800	200	0	2,700	1,000	1,200	1,100	4,700	1,400	300	2,200	18,600
1984	0	200	200	500	200	100	2,700	700	0	3,700	1,200	7,000	1,700	7,400	2,200	500	6,300	34,600

1985	400	400	200	200	100	200	2,700	200	0	1,500	1,700	300	1,500	8,400	1,900	200	1,800	21,700
1986	400	400	0	100	400	0	2,600	600	0	900	3,200	600	300	5,700	1,200	400	2,200	19,000
1987	300	300	0	0	100	100	1,400	100	0	2,300	800	1,500	700	3,000	2,800	500	1,900	15,800
1988	300	300	0	100	200	0	1,000	0	0	800	700	200	500	1,100	700	0	1,300	7,200
1989	100	200	0	200	100	200	1,500	200	0	1,500	800	700	700	3,900	1,000	400	3,000	14,500
1990	400	500	0	300	100	TR**	1,700	300	0	400	700	1,400	300	3,200	500	0	700	10,500
1991	200	200	0	0	0	0	600	200	0	700	2,200	800	100	6,500	800	100	1,800	14,200
1992	0	200	0	400	100	TR**	700	100	0	900	500	1,600	500	5,900	100	300	1,300	12,500
1993	100	TR**	100	TR**	0	0	1,300	300	0	900	1,300	1,300	800	3,500	2,700	0	500	12,900
1994	300	400	0	100	200	100	2,100	100	0	1,400	1,500	1,300	1,200	4,800	2,700	300	1,900	18,300
1995	400	1,000	100	200	200	200	1,400	300	0	700	1,900	4,400	2,500	10,100	5,200	1,000	3,800	33,200
1996	100	600	100	TR**	100	200	1,200	300	0	1,300	1,100	3,400	2,100	5,000	1,200	100	2,500	19,300
1997	300	TR**	TR**	100	0	100	1,900	700	TR**	1,700	3,800	3,600	1,600	4,200	1,800	0	4,200	24,000
1998	400	400	0	100	200	TR**	1,600	700	0	3,200	2,900	6,200	2,500	7,000	2,600	1,200	4,800	33,600
AVERAGES:																		
61-65	360	260	40	240	80	80	1,240	760	20	2,260	740	2,100	1,960	3,500	1,000	140	5,760	20,540
66-70	680	340	80	420	220	60	3,580	600	0	2,360	1,560	2,840	3,640	6,220	2,060	460	9,080	34,200
71-75	400	240	180	180	100	40	3,120	780	0	4,560	1,460	3,180	3,820	5,440	2,700	500	3,880	30,580
76-80	480	380	40	360	240	114	3,880	1,020	100	4,160	1,700	3,020	2,440	8,340	5,400	460	11,060	43,194
81-85	380	440	100	360	140	160	3,180	480	40	2,980	1,420	2,740	1,320	8,600	1,960	320	3,660	28,280
86-90	300	340	0	140	180	75	1,640	240	0	1,180	1,240	880	500	3,380	1,240	260	1,820	13,400
91-95	200	450	40	175	100	75	1,220	200	0	920	1,480	1,880	1,020	6,160	2,300	340	1,860	18,220

Appendix 6. Estimated numbers of pintails harvested, season length (days), bag limit (bag), and the midwinter index (MWI) for the Atlantic Flyway. Information reprinted from Runge and Boomer (2005).

Year	Harvest	HIP[a]	Days	Bag	MWI
1979	48462	0	50	4	72,071
1980	38869	0	50	4	54,492
1981	27891	0	50	4	67,962
1982	38632	0	50	5	68,900
1983	18636	0	50	5	48,100
1984	34658	0	50	5	46,200
1985	21685	0	40	2	34,000
1986	19033	0	40	2	47,400
1987	15788	0	40	1	36,900
1988	7447	0	30	1	36,235
1989	14588	0	30	1	55,093
1990	10493	0	30	1	43,995
1991	14201	0	30	1	68,937
1992	12470	0	30	1	42,705
1993	12923	0	30	1	51,374
1994	18340	0	40	1	61,510
1995	33163	0	50	1	50,626
1996	19270	0	50	1	34,606
1997	24010	0	60	3	43,165
1998	33594	0	60	1	45,419
1999	29527	0	60	1	65,259
2000	22384	0	60	1	37,890
2001	19950	0	60	1	47,902
1999	25200	1	60	1	65,259
2000	20752	1	60	1	37,890
2001	19276	1	60	1	47,902
2002	17089	1	30	1	48,139
2003	18134	1	30	1	36,324
2004					55,523

[a]HIP = data collected under the USFWS Harvest Information Program.

Appendix 7. Harvest estimates for pintails in eastern Canada (CWS Waterfowl Committee 2005*a*).

YEAR	NFL	PEI	NS	NB	QUE	ONT	TOTAL
1972	1.000	400	400	400	16,900	9,700	28,800
1973	2,600	500	1,100	1,000	19,400	10,500	35,100
1974	1,100	1,100	1,300	1,300	21,000	10,800	36,600
1975	900	400	500	800	22,000	9,700	34,300
1976	1,300	700	1,000	1,700	29,000	17,300	51,000
1977	2,400	1,800	1,200	1,000	40,600	14,500	61,500
1978	900	800	700	1,400	20,600	13,200	37,600
1979	1,800	600	500	1,100	15,300	9,100	28,400
1980	900	500	700	1,300	17,100	13,300	33,800
1981	1,100	800	1,000	1,200	17,500	11,600	33,200
1982	0	1,600	1,100	1,500	20,300	10,200	34,700
1983	2,300	600	700	300	16,300	10,600	30,800
1984	1,700	1,100	700	900	9,500	35,500	49,400
1985	1,600	1,000	1,400	1,800	16,500	15,300	39,600
1986	700	600	800	1,700	13,000	9,300	26,100
1987	1,100	1,800	600	1,100	11,900	6,300	22,800
1988	2,200	1,300	500	800	12,600	8,000	25,400
1989	1,500	700	300	1,400	15,600	11,500	31,000
1990	4,400	500	700	1,700	19,800	8,300	35,400
1991	400	600	900	800	7,600	4,300	14,600
1992	0	904	84	473	6,327	4,857	12,645
1993	1,133	1,228	911	682	11,113	4,946	20,013
1994	946	707	1,093	1,084	10,887	4,526	19,243
1995	1,727	454	965	1,240	7,831	4,552	16,769
1996	1,246	478	897	1,234	5,043	4,011	12,909
1997	785	139	116	493	7,423	5,560	14,516
1998	1,026	0	653	757	7,735	6,361	16,532
1999	390	1,137	755	1,790	8,956	6,457	19,485

Appendix 7. Harvest estimates for pintails in eastern Canada (continued).

YEAR	NFL	PEI	NS	NB	QUE	ONT	TOTAL
2000	470	509	499	581	6,480	5,397	13,936
2001	137	0	401	611	4,911	3,709	9,769
2002	1,153	78	543	702	5,527	9,910	17,913
2003	527	598	228	1,270	6,795	10,422	19,885
2004*	30	317	129	702	6,394	5,208	12,780
AVERAGES:							
72-75	1,400	600	825	875	19,825	10,175	33,700
76-80	1,460	880	820	1,300	24,520	13,480	42,460
81-85	1,340	1,020	980	1,140	16,020	16,640	37,140
86-90	1,980	980	580	1,340	14,580	8,680	28,140
91-95	841	779	791	856	8,752	4,636	16,382
96-00	783	453	584	971	7,127	5,557	15,475
01-04	473	248	325	821	5,907	7,312	15,086

*PRELIMINARY

Appendix 8. Sales of migratory Game Bird Hunting Permits in Canada (CWS Waterfowl Committee 2005*b*).

Season	NF	PE	NS	NB	QC	ON	MB	SK	AB	Be	NT INU	YT	NU	Canadal
1966	13,269	3,271	7,220	8,535	35,868	144,063	37,784	44,744	52,911	32,394				380,059
1967	14,863	3,094	7,883	7.739	32,491	146,493	35,620	44,651	55,892	33,195				383,032
1968	17,645	3,649	9,022	9,558	37,110	139,182	38.712	43,596	53,623	33,301				385,553
1969	19,089	3.794	8,848	10.110	39,477	134,037	41,611	45,347	53,602	32.764				389,325
1970	21,347	3,962	9,926	10,293	46,009	135,231	39,230	47.722	59,986	31,350				405,650
1971	23,460	4,513	11,381	11,146	50,276	133,563	40,960	49,448	62,902	30,225				418,237
1972	23,682	4,492	12,158	11,336	53,082	131,427	41,133	50,004	63,309	31,032				421,677
1973	27,919	4,972	15,071	12,869	57,247	141,277	41.711	51,307	67,012	33,456				452,841
1974	25,127	5,038	13.791	11,916	58,345	136,469	37,167	51,504	66,127	27.764	591	323		434,162
1975	30,115	4,963	13,990	12,930	63.768	148,670	42,846	57.723	69,191	25,918	721	485		471,320
1976	29,621	5.756	13,326	13,743	66,453	143,816	46,681	61,669	75.739	26,561	893	513		484.771
1977	36,188	6,158	15.744	14,209	72,828	156,895	46,438	60,029	82,175	28,357	902	607		520,530
1978	37,297	6,396	16,297	15,249	74.745	159,698	50,169	57,958	77,117	28,561	821	638		524,946
1979	35,490	5,888	14,098	13,409	73,209	150,224	49,344	56.174	77,021	28,263	755	584		504,459
1980	31,362	5,802	14,257	12,471	76,133	147,952	48,340	54,081	79,318	27,943	732	525		498,916
1981	31,401	5,611	14,130	12,287	75,178	141,677	46,528	42,856	66,163	28,243	764	514		465,352
1982	31,215	5,461	13.728	12.759	72,850	144,436	45,273	47,236	64,968	26,522	800	572		465,820
1983	30,977	5,898	13,468	12,758	67,700	139,569	40,443	45,383	61.742	24,170	750	474		443,332
1984	31,309	5,525	12,896	11,486	65,308	140,521	35,238	37.720	51,717	21,892	850	496		414,958
1985	25,652	5,171	10.749	10,354	60,823	130,089	31.753	36,445	44,880	18.753	713	361		375.743
1986	25,498	5,300	11,047	11,083	59,685	131,930	33,570	37,692	45,042	17,924	692	358		379,821
1987	21,080	4,959	10,299	9,897	55,124	122,472	30,207	29,930	40,122	16,259	523	391		341,263
1988	23,655	4,906	10,264	10,646	57,206	117,310	25,108	23,258	34,513	15,595	496	367		323,324
1989	24,707	4,838	10,092	9,971	54,605	114,292	23,898	22,916	34,559	14,694	420	308		315,300
1990	24,831	4,625	10,115	9,974	54.700	115,130	22,641	22,964	32,212	13,851	431	240		311.714
1991	20,738	4,209	10,104	9,997	53.739	108,802	22,122	22,414	29,399	13,601	352	300		295,777
1992	20,310	3,753	9,192	9,337	49,262	103,395	20,048	20,620	28,056	12,429	348	256		277,006
1993	20,585	3,609	8,988	9,008	47,675	95,824	19,199	19.771	26.787	11,818	327	287		263,878
1994	20,399	3,380	9,314	9,468	46,537	92,344	18,838	20,254	26,211	11,037	320	294		258,396
1995	20,231	3,479	9,176	8,674	38,955	83,720	19,630	20,554	25,747	9,855	342	318		240,681
1996	16,312	3,303	8,652	8,536	36,004	80,194	19.702	20,475	27,299	10,069	318	306		231,170
1997	14,289	3,051	7.731	7,546	31,435	72,521	18,918	20,109	26,847	10,185	278	268		213,178
1998	13,101	2,946	7,681	7,095	30,113	70,407	18,445	21,822	22,238	9,816	286	231		204,181
1999	13,111	2,671	7,410	6,821	30,124	67,077	17,433	21,685	21,415	9,314	292	231		197,584
2000	12,217	2,805	7,072	6,399	30,271	63,672	15,810	21,908	21.792	9,007	267	224	0	191,444
2001	16,998	2,416	6,645	5,975	29,138	58,458	15,038	18,387	19,527	8,185	223	251	20	181,261
2002	16,056	2,341	6,316	5,942	28,702	56,645	14,832	16,958	17,814	7,464	244	217	24	173,555
2003	15,626	2,316	5,926	6.065	29,376	56,911	15,124	18,155	18,372	6,509	234	159	12	174,794
2004	14,642	2,208	5,413	5,400	28,818	55,066	14,071	19.796	18,661	5.713	180	165		170,133

ı *Total permit sales from* 1967/0 1972 *include* some *sales where the province* of *sale* was *not recorded.*

Data soun:e: M. *Gendron and B. Collins (CWS).*

Appendix 9. Estimated harvest and ratios of immature and adult northern pintails in the Canadian harvest, 1975-2005. Data source: M. Gendron and B. Collins, CWS.

	Eastern Canada[a]			Man/Sask			Western Canada[b]		
Year	Imm	Ad	Imm/Ad	Imm	Ad	Imm/Ad	Imm	Ad	Imm/Ad
1975	30,990	3,567	8.69	65,243	11,277	5.79	90,519	14,945	6.06
1976	40,645	8,879	4.58	40,349	11,886	3.40	75,855	22,684	3.34
1977	53,958	6,420	8.41	20,700	11,011	1.88	72,801	26,705	2.73
1978	31,955	6,128	5.22	28,751	6,370	4.51	45,809	15,756	2.91
1979	23,616	4,448	5.31	43,622	6,709	6.50	56,466	10,462	5.40
1980	30,245	3,041	9.95	18,678	11,059	1.69	46,610	18,782	2.48
1981	28,412	4,059	6.70	14,960	3,593	4.16	35,597	22,893	1.56
1982	29,234	6,381	4.58	20,172	5,715	3.53	36,962	6,186	5.98
1983	26,098	4,863	5.37	24,156	4,093	5.90	35,304	7,096	4.98
1984	21,045	2,712	7.76	21,050	4,422	4.76	43,129	10,713	4.03
1985	33,646	3,709	9.07	14,460	3,476	4.16	29,838	5,468	5.46
1986	21,135	4,970	4.25	12,289	3,774	3.26	14,064	3,452	4.07
1987	19,458	3,081	6.32	11,738	2,125	5.52	24,707	5,905	4.18
1988	19,773	4,921	4.02	12,477	6,662	1.87	19,021	6,492	2.93
1989	27,541	3,241	8.50	9,633	2,291	4.21	14,536	5,705	2.55
1990	28,209	6,568	4.30	10,958	4,297	2.55	16,353	5,198	3.15
1991	12,766	3,965	3.22	4,955	3,475	1.43	8,504	1,476	5.76
1992	8,785	3,745	2.35	5,621	1,739	3.23	10,981	2,460	4.46
1993	16,166	4,369	3.70	5,826	2,596	2.24	6,870	1,914	3.59
1994	18,400	1,548	11.87	8,967	3,198	2.80	9,955	2,299	4.33
1995	14,127	2,633	5.37	11,607	3,884	2.99	9,754	2,294	4.25
1996	9,202	3,704	2.48	17,402	7,395	2.35	9,732	5,254	1.85
1997	12,114	2,395	5.06	21,221	5,681	3.74	14,320	5,019	2.85

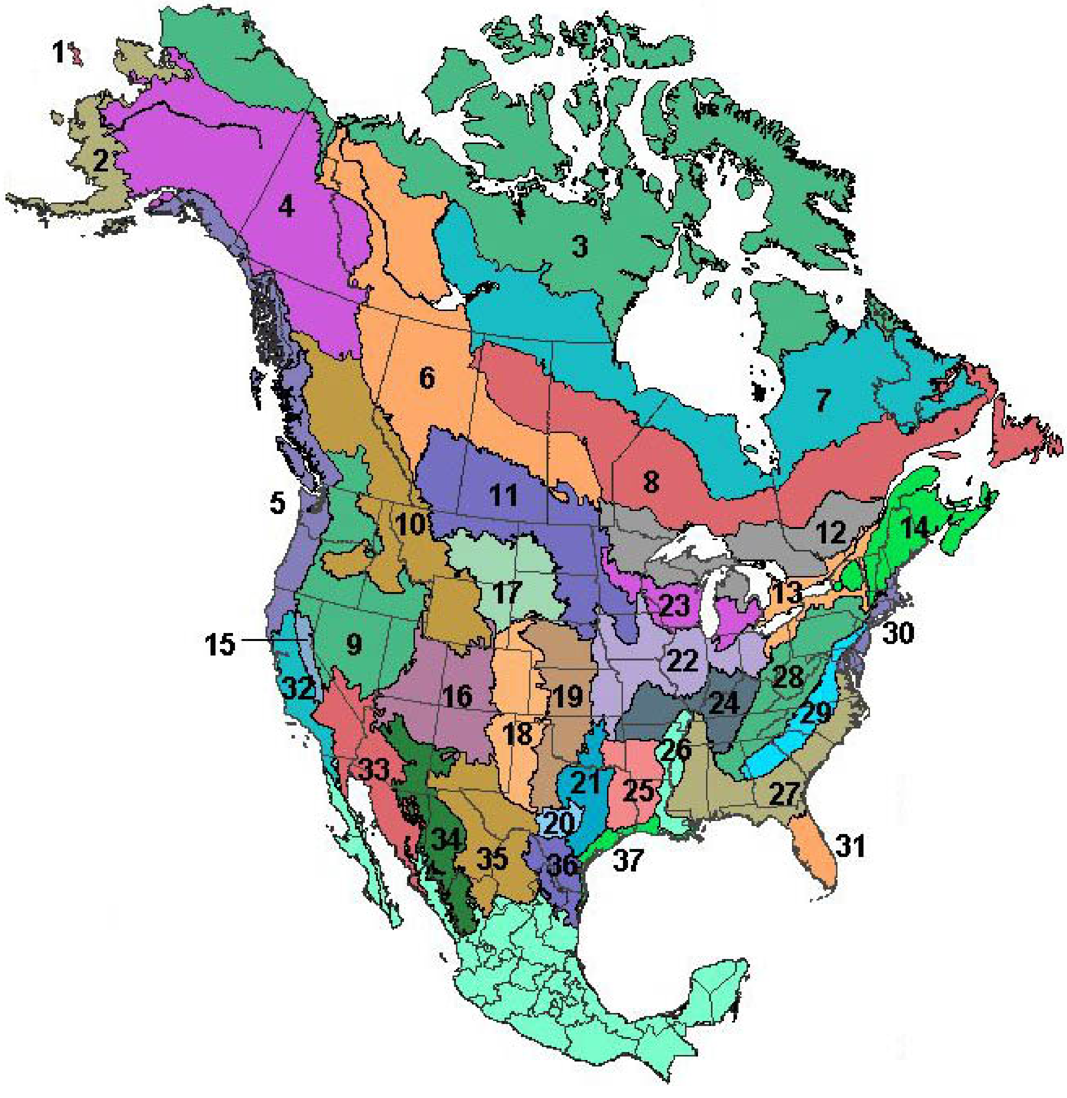
[a]Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland.
[b]Alberta, British Columbia, Northwest Territories, and Yukon Territory.

Appendix 9 (continued).

	East			Man/Sask			Other		
Year	Imm	Ad	Imm/Ad	Imm	Ad	Imm/Ad	Imm	Ad	Imm/Ad
1998	14734	1795	8.21	18509	6934	2.67	11271	6325	1.78
1999	17163	2315	7.41	14792	5645	2.62	9430	6338	1.49
2000	11376	2554	4.45	11814	10346	1.14	10270	9206	1.12
2001	8342	1423	5.86	10143	6122	1.16	7595	5959	1.28
2002	16155	1753	9.22	18379	8552	2.15	7033	5156	1.36
2003	17202	2678	6.42	14559	3126	4.66	7594	2791	2.72
2004	9089	3687	2.47	22710	13714	1.66	7758	2982	2.60
2005	7774	1487	5.23	15363	4738	3.24	12401	2042	6.07

[a]Ontario, Quebec, New Brunswick, N ova Scotia, Prince Edward Island, and Newfoundland.
[b]Alberta, British, Columbia, Northwest Territories, and Yukon Territory.

Appendix 10. Bird Conservation Areas (NABCI 2000).



(3) Arctic Plains and Mountains

Description: This region includes low-lying, coastal tundra and drier uplands of the Arctic mountains across the entire northern edge of North America. Because of thick and continuous permafrost, surface water dominates the landscape (20-50% of the coastal plain). Freezing and thawing form a patterned mosaic of polygonal ridges and ponds and many rivers bisect the plain and flow into the Arctic Ocean. The ocean surface is generally frozen 9 to 10 months a year, and the ice pack is never far from shore. Because of the wetness, waterfowl and shorebirds dominate the avian community and passerines are scarce. Few bird species winter in the region.

(6) Boreal Taiga Plains

Description: The Boreal Taiga Plains region is dominated by the Mackenzie River and its tributaries in its northern portion and the boreal transition zone in the south. Black spruce is a dominant species in the open, coniferous forests of the north, while the warmer better-drained southerly locales support mixed-wood forests of white and black spruce, lodgepole pine, tamarack, white birch, trembling aspen, and balsam poplar. Low-lying wetlands cover 25%-50% of the zone, and patterned ground features are common. A large portion of the area is underlain by permafrost, creating a landscape that is seasonally waterlogged over large areas. Coastal areas winter large numbers of Canvasback, Mallard, American Wigeon, Redhead, and the majority of the continent's population of Tundra Swans. Managed impoundments in coastal areas are important to migrating and wintering dabbling ducks, including American Black Duck.

(7) Taiga Shield and Hudson Plains

Description: This BCR includes the Hudson Plains – the largest extensive area of wetlands in the world – and extends east and west onto the Canadian Shield. The subarctic climate is characterized by relatively short, cool summers with prolonged periods of daylight and long, very cold winters. The poorly drained areas of the Hudson Plains support dense sedge-moss-lichen covers, with open woodlands of black spruce and tamarack in better-drained sites. Coastal marshes and extensive tidal flats are present along the coastline. The Canadian Shield is characterized in upland sites and along rivers by open, mixed-wood forests of white spruce, balsam fir, trembling aspen, balsam poplar, and white birch. Farther north, approaching the limit of tree growth, stunted black spruce and jack pine dominate, accompanied by alder, willow, and tamarack in the fens and bogs. Thousands of lakes and wetlands occur in glacially carved depressions, and peat-covered lowlands are commonly waterlogged or wet for prolonged periods due to discontinuous but widespread permafrost. The abundance of water provides an important habitat for breeding waterfowl.

(8) Boreal Softwood Shield

Description: The Boreal Softwood Shield is a broad, U-shaped region comprised of seacoasts in the east and vast areas that are more than 80% forested by closed stands of conifers, largely white and black spruce, balsam fir, and tamarack. Toward the south, broadleaf trees, such as white birch, trembling aspen, and balsam poplar are more widely distributed, as are white, red, and jack pine. The region is a broadly rolling mosaic of uplands and associated wetlands, dotted with numerous small to medium-sized lakes. Peatlands are common in wetland areas.

(11) Prairie Potholes

Description: The Prairie Potholes is a glaciated area of mixed grass prairie in the west grading toward tallgrass prairie in the east. This is the most important waterfowl producing region on the North American continent despite extensive wetland drainage and tillage of native grasslands. Breeding dabbling duck density may exceed 100 pairs/mi^2 in some areas during years with favorable wetland conditions. The region comprises the core of the breeding range of most dabbling duck and several diving duck species, as well as providing critical breeding and migration habitat for >200 other bird species. Continued wetland degradation and fragmentation of remaining grasslands threaten future suitability of the prairie pothole region for all of these birds.

(12) Boreal Hardwood Transition

Description: This region is characterized by coniferous and northern hardwood forests, nutrient poor soils and numerous clear lakes, bogs, and river flowage. Great Lakes coastal estuaries, river flowage, large shallow lakes, and natural wild rice lakes are used by many breeding and migrating waterbirds. Although breeding ducks are sparsely distributed, stable water conditions allow for consistent reproductive success. Threats to wetland habitat in this region include recreational development, cranberry operations, peat harvesting, and drainage.

(13) Lower Great Lakes/St. Lawrence Plain

Description: The Lower Great Lakes/St. Lawrence Plain covers the low-lying areas to the south of the Canadian Shield and north of various highland systems in the United States. In addition to important lakeshore habitats and associated wetlands, this region was originally covered with a mixture of oak-hickory, northern hardwood, and mixed-coniferous forests. Very little of the forests remain today due primarily to agricultural conversion. Because of agriculture, this is now the largest and most important area of grassland in the Northeast. But, increasingly, agricultural land is being lost to urbanization. This physiographic area also is extremely important to stopover migrants, attracting some of the largest concentrations of migrant passerines, hawks, shorebirds, and waterbirds in eastern North America. Much of these concentrations are along threatened lakeshore habitats.

(14) Atlantic Northern Forest

Description: The nutrient-poor soils of northernmost New England and the Adirondack Mountains support spruce-fir forests on more northerly and higher sites and northern hardwoods elsewhere. Beaver ponds and shores of undisturbed lakes and ponds provide excellent waterfowl breeding habitat. The Hudson and Connecticut River Valleys are important corridors for waterfowl migrating from New England and Quebec. Because inland wetlands freeze, coastal wetlands are used extensively by dabbling ducks, sea ducks and geese during winter and migration.

(22) Eastern Tallgrass Prairie

Description: This region formerly included the tallest and lushest grasslands of the Great Plains. Beech-maple forest dominated in the eastern sections, and the prairie and woodland ecotone between the 2 was marked by a broad and dynamic oak-dominated savannah. The modern landscape of the Eastern Tallgrass Prairie is dominated by agriculture. Threats to the upland and wetland habitats of this region include urbanization, recreational development, and agricultural expansion.

(23) Prairie Hardwood Transition

Description: Prairies once dominated this region in the west and south and beech-maple forest in the north and east, separated by an oak savannah. Glaciation has resulted in numerous pothole-type wetlands and shallow lakes, and the Great Lakes coastal estuaries are the destinations of many rivers. Additional important waterfowl lakeshore-wetland habitats range from emergent marshes and diked impoundments to normally ice-free deepwater habitats valuable for diving ducks. This region is second only to the Prairie Pothole region in terms of supporting high densities of breeding waterfowl.

(27) Southeastern Coastal Plain

Description: This region includes extensive riverine swamps and marsh complexes along the Atlantic coast. Interior forest vegetation is dominated by longleaf, slash, and loblolly pine forests. Coastal areas winter large numbers of Canvasback, Mallard, American Wigeon, Redhead, and the majority of the continent's population of Tundra Swans. Managed impoundments in coastal areas are important to migrating and wintering dabbling ducks including American Black Duck.

(30) New England/Mid-Atlantic Coast

Description: This area has the densest human population of any region in the country. Much of what was formerly cleared for agriculture is now either in forest or residential use. Estuarine complexes and embayments created behind barrier beaches in this region are extremely important to wintering and migrating waterfowl, including approximately 65% of the total wintering American Black Duck population along with large numbers of Greater Scaup, Tundra Swan, Gadwall, Brant, and Canvasback. Exploitation and pollution of Chesapeake Bay and other coastal zones and the accompanying loss of submerged aquatic vegetation, have significantly reduced their value to waterfowl.

(31) Peninsular Florida

Description: The northern portion of Peninsular Florida is a transitional zone where the pine and bottomland hardwood elements of the Coastal Plain begin to merge with the tropical elements of south Florida. Farther south, in the subtropical zone of the state, normally frost-free climate creates conditions for mangroves, everglades, and tropical hummocks, tying this area more closely to the Bahamas and Caribbean than to the rest of the United States. Wintering waterfowl abound in coastal waters, including large numbers of Lesser Scaup, Ring-necked Duck, and Green-winged Teal. Three species of waterfowl, the endemic Florida subspecies of Mottled Duck, Wood Duck, and Fulvous Whistling-Duck, also breed in the area. Most of the nesting Snowy Plovers remaining in the Southeast occur along Florida's Gulf Coast. Extraordinary numbers of wintering and in-transit shorebirds also use the region, particularly Short-billed Dowitchers, but also including Piping Plover, Dunlin, and Red Knot.